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Electrical World

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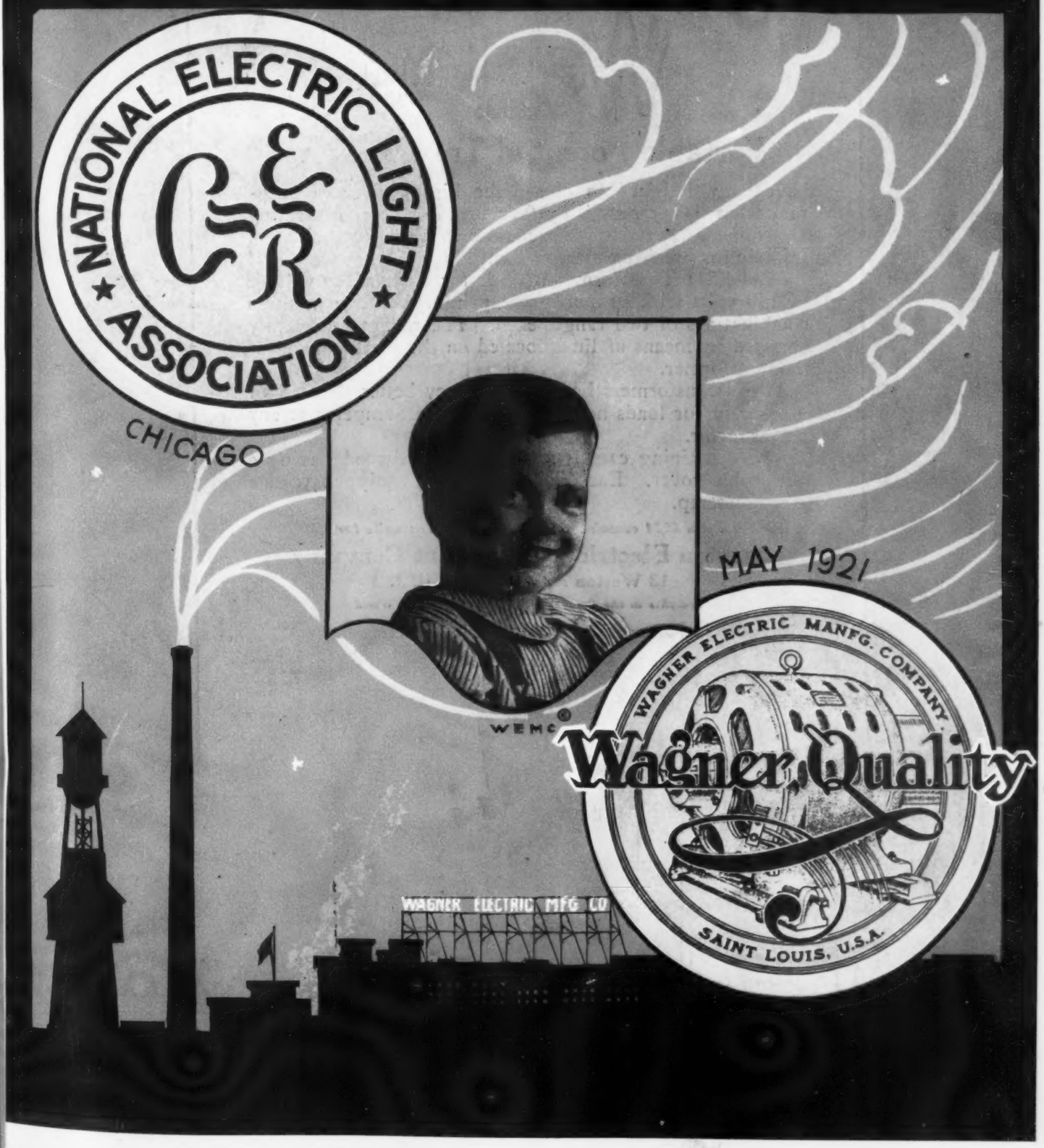

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A Bold Prophecy that Warrants Interest

WITHIN one year electron tubes will be used for rectifying alternating current for series street-lighting purposes, and in five years, perhaps, they will be replacing the synchronous converter, according to opinions expressed by Dr. Albert W. Hull before the A. I. E. E. last week. In ten years, he predicted, they will be on electric locomotives, and twenty years will see direct-current transmission lines fed through transformers and electron tubes. This is a rather bold prophecy considering the attempts which have been made to displace heavy rotating equipment by static devices, but it deserves attention and interest in view of the steady success obtained with electron tubes during the past few years. Today electron tubes perform many of the most important functions in telephone and telegraph transmission. During recent years, moreover, power engineers have found electron tubes useful where large current values are not required, for such purposes as cable testing and smoke precipitation.

Credit Due to the Average-Sized Central-Station Company

REQUIREMENTS of electric service in metropolitan districts and the proportions of development problems connected with building large transmission networks have frequently overshadowed the work done in the small and average-sized community. Nevertheless, it is the universal availability of electric service to the humble homes as well as the more luxurious and to the small isolated factories as well as the great industrial institutions that has advanced the central-station industry to the commanding position it now occupies as an essential factor in our social and business life. To the executives and the engineers in towns of average size who are successfully struggling with financial and operating problems to maintain high quality of service is due in some cases an individual credit equal to if not greater than that deserved by those in companies associated with large financial interests from which assistance can be depended upon in the extension and maintenance of physical properties. It takes a broad vision and a loyalty to ideals of service to invest money in small public utility enterprises with a regulated rate of return when there are so many opportunities to invest in enterprises which combine safety and speculative return on a more attractive and an unregulated basis. With just pride the electrical industry can boast of the high ideals of its executives. And to these men, particularly those associated with the average-sized electric utility, this issue of the ELECTRICAL WORLD is dedicated. In its columns are reflected their ideas and their problems, a testimony of progress that should be an inspiration to the industry as a whole. When it is realized that 95 per cent of the 5,700 central-station companies of this country operate stations rated under 10,000 kw., the important position of the average-sized company in the future development of electric service is revealed.

The National Electric Light Association

THE National Electric Light Association, which holds its convention next week in Chicago, is not only the dominant electrical association in the country but admittedly the most progressive and energetic public utility association of the world. Approximately 95 per cent of the total electric public utility output of the United States is generated by its members, so that all of its conventions and actions command attention. There is no phase of the electric light and power business that is not within its grasp, and yet the giant has never been known to misuse its power. The association has 174 committees at work, the personnel of which includes more than a thousand experts who meet at regular intervals to discuss what is best for the business and to exchange knowledge, experiences and ideas. Their deliberations lead to but one end—greater efficiency in the production and distribution of electricity. Freedom and frankness, which are lacking among other gatherings of executives and engineers, characterize the meetings, because, the business not being a competitive one, there are no secrets to guard and all contributions are made for the general good. The inevitable result is progress, which manifests itself in improved practices or machinery and in higher standards of service. Therefore, to the National Electric Light Association more than to any other body must credit be given for the almost universal use and application of electricity in this country. Other organizations may have suggested and proposed, others may have even anticipated the National Electric Light Association in certain directions, but unless and until the work received the stamp of approval of the National Electric Light Association it was without effect. To appreciate what this means one has but to compare the quantity of electricity produced and used in the United States with that in any other country in the world. Clearly indicated also are the benefits accruing to the nation through the genius, initiative and enterprise of private business. No city of itself can command such an array of expert talent as is made available to any one company through membership in the National Electric Light Association, and yet every city can receive the benefit of the aggregate experience, knowledge and skill of these men. Chicago is a typical example. It possesses some of the largest and most efficient steam-electric generating stations in the world, and its service is unsurpassed. So broad in extent and intensive in application is the work of the

Commonwealth Edison Company that its total kilowatt-hour output exceeds the output of a dozen or more of the smaller states combined and is not far short of the total generated in England, Scotland, Ireland and Wales. The genius and enterprise shown by Samuel Insull and reflected in the entire Commonwealth organization are typical of the spirit animating the National Electric Light Association. Regulated as to service and rates by public utility commissioners throughout the country, the increased efficiency and economy brought about as a result of research, experiments, tests and studies bring no direct financial rewards to electric light and power companies or their stockholders other than the very limited return allowed on the investment. The work of the National Electric Light Association, therefore, while it is most indispensable, essential and vital to its members, is largely a labor of love in the service of the public, which benefits through more and better service at minimum cost. Animated by this spirit, the association has grown to its present stature. The coming meeting at Chicago, in recording progress and marking out future paths, will but intensify the will to serve.

Useful Charts for Quick Solution of Short-Line Problems

TRANSMISSION engineers are frequently confronted with the problem of estimating the cost of conductor or of power loss in transmitting a given amount of power at a known power factor to a known distance at a given voltage between conductors. The problem is more complex than in any corresponding direct-current case because the power factor of the load and the distance between the line conductors enter the problem. In all such cases it is advantageous to be able to refer, for first approximations, to graphic charts or to solve short-line problems in this manner.

E. P. Peck presents this week a set of curves for each of a series of sizes of copper-line conductor by reference to which a very simple computation of the percentage voltage drop in transmission can be estimated speedily to a very fair degree of precision. These curves will be found very helpful by transmission engineers in practical work. Of course, when careful estimates have to be made for long lines the results arrived at by the aid of the curves must be supplemented by more elaborate and accurate methods.

Sunspots, Auroras and Disturbances in Communication Circuits

THE recent auroral displays witnessed in the United States were accompanied, as usual, by powerful electromotive forces and currents in telegraph and telephone lines. Fuses were melted and a few cables were damaged. It is now generally admitted that a violent storm on the sun's surface is accompanied by a relatively dark area, or sunspot, which may be many thousands of kilometers in diameter. Finely divided electrified matter is believed to be projected outward from this area at a high velocity, like an electrified jet of gas. In about thirty hours these jets reach the earth's orbit. If they are so directed as to hit the earth, the electrified substance, penetrating into the atmosphere, becomes arrested and entangled therewith at an elevation of say 100 km. above the earth's surface. Electrical disturbances in this layer set up corresponding electric and magnetic disturbances on the earth's surface. The aurora is the rarefied gaseous discharge visible in the upper atmosphere, and, as Elihu Thomson has pointed out, usually consists in our latitudes of a set of parallel streamers, nearly vertical. The terrestrial disturbances are those which are set up by electric and magnetic induction at the bottom of the atmosphere. They fluctuate in magnitude and in sign, in general conformity with the fluctuations in the streamer discharges of the upper air.

The Progress of Ornamental Lighting

FOR a few years past we have had little increase in street lighting, either ornamental or otherwise, on account of war conditions. There have been plenty of street lamps installed, but they have been the result of necessity and not a part of the orderly progress of the art. A paper on another page by Arthur J. Sweet, well known for his activity in modern street lighting, gives a conspective view of the situation as it now exists with the war conditions alleviated. Of late there has been a realization that the costs of labor and material are on the down grade, and although far from pre-war levels, have reached the point where there is encouragement toward construction. It is therefore to be expected that street lighting in the next year or two will take on a new activity, particularly in its ornamental phase. Strictly utilitarian equipment also will naturally increase, but the community nowadays tends to demand something in the line of fixtures and equipment a little better looking than would be the mere product of necessity. Just now the concrete posts are competing with cast iron for attention. Just which will possess the public favor a few years from now is, to say the least, a little uncertain. The concrete posts have worked well on the whole and their use should spread. Against them there is the present lessened cost of the iron posts and in particular the heavier appearance of the concrete structure.

One change on which the public is to be congratulated is the abandonment of the particularly inartistic and inefficient cluster type globes. They are never economical and look well only in the rare cases where they are skillfully designed and in surroundings which harmonize with their structure. The present tendency is toward single lamps with prismatic reflectors, these greatly improving the distribution of light. With this better distribution there has been a very definite movement toward greater mounting heights. The early ornamental practice was abominable in the proportion of glare to illumination, a defect due to bringing powerful lights, supposed to give a brilliant effect, down close to the eyes of the passersby. The higher post gives vastly better distribution and in city lighting gives also a better illumination of the façades of buildings and a more brilliant appearance to the street as a whole.

With these improvements have come a spacing better proportioned to the requirements of the situation and to the increase in intensity. Mr. Sweet holds with most well-informed illuminating engineers that the intensity should be pushed high for the main thoroughfares, up to a quarter or a half foot-candle in fact, with proportionate decrease in less important situations. As regards the illuminants proper, Mr. Sweet bears in mind particularly the powerful incandescent lamps and expresses himself strongly in favor of the constant-current regulator with a film cut-out socket. There is considerable difference of opinion as to whether it is better to

use this straight system or one with compensators and somewhat higher current at the lamps. Practice is split at this point, but with many installations of each kind in use it should not be difficult presently to accumulate a stock of experience which will give a definite basis for decision between the two methods.

The Electrical Industry Suffers Loss

BY THE death of Dr. Rosa and Franklin K. Lane the electrical industry has lost two stanch friends. As a physicist Dr. Rosa did very excellent and brilliant work, which was recognized internationally and which added luster to his name as well as to the annals of the Bureau of Standards. As a sociologist his work was not so productive of results, and it was always a moot question whether as a sociologist Dr. Rosa was ever so happy or so famous as he was as a physicist. He was a painstaking and conscientious worker, however, animated by the highest motives, and the electrical industry mourns his loss. Of Franklin K. Lane too much in admiration and praise cannot be said. As Secretary of the Department of the Interior he was indefatigable in awakening the American people to a realization of the tremendous value of the nation's natural resources and to the necessity of their development. He was the father of the idea of the Federal Power Commission, and his consistent stand for and vigorous advocacy of a water-power bill fair alike in its provisions to the investor and to the public was characteristic of the man. But the electrical industry was not alone in its warm affection for Mr. Lane. He endeared himself to all classes by his broad humanity and unalloyed Americanism, and his death at a comparatively early period of life is a national calamity.

Some Lessons in Middle West Utilities Development

THE system of the Middle West Utilities Company affords an interesting opportunity to study the effects of grouping properties under a single control. The properties are scattered, and while there are fair-sized cities and rich industrial districts in the territory, a large portion of the service is in small and scattered communities. Plants on the original properties were small and inefficient, and service was of the same order as the plants.

Two things stand out on a first analysis of the data presented elsewhere in this issue on the operation of this successful company. The first is that more old plants have been abandoned since the consolidation was begun in 1912 than are now operating either on a constant or an emergency basis. Closely related to this development is the reduction of the average coal used per kilowatt-hour from 8.9 lb. in 1915 to 4.98 lb. in 1920. These two physical facts are tangible evidences of improvements of which the giving of service for the full twenty-four hours of the day as a result of interconnection and the increase in operating efficiency are also forceful proofs. These things are seldom brought effectively to public attention. They are naturally followed by the less tangible improvements, such as better commercial service, increased opportunity to utilize electrical energy and other evidences of progress, that bring the small community service to a par, comparatively, with city service.

The problems involved in the handling of these properties are becoming of increasing importance, particularly in the area lying between the Allegany and Rocky Mountains, where there is a great deal of territory that until now has gone without electric service or at best limped along on night service. The education of the consuming public to the advantages of electric service is bringing the small central-station company to a crisis that has been intensified on one hand by the demands for better service and on the other by the increased labor and material costs. Many of the small stations have reached a point where the service demanded of them cannot be given at a price that the public can pay because they have not and cannot afford the plant facilities necessary. The answer lies in an increased tying up of properties to central sources of power and in such a pooling of community ability to pay as will permit service facilities that no one community can afford.

Much of our previous engineering has dealt with service where the element of cost has been a smaller factor than the question of the best methods of obtaining specific results. The engineer is now facing the problem of better service to the rural districts, the small community and the small industry. His problem is not one of pure engineering, but one of commercial engineering in the strictest sense of the word, and its dual nature will force the development of a far higher type of engineering and managerial ability than we have hitherto known.

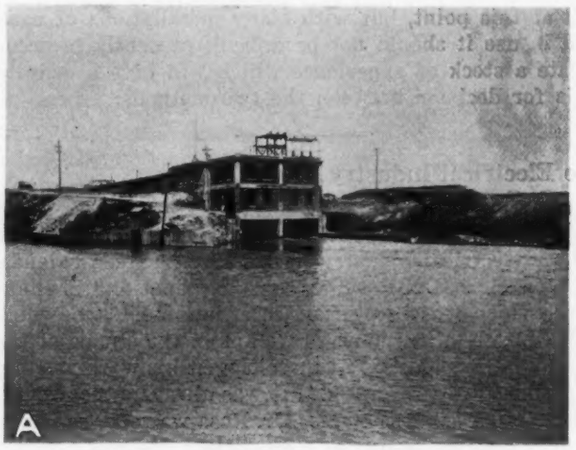
Unusual Method for Collecting Bills in Rural Communities

A BRIEF article by B. W. Little in the current issue gives an account of how one rural electric system met the difficult problem of efficient collections in a scattered territory. The plant in question is in South Carolina and operates its distribution system in three towns and the intervening country. The first method tried was appointing a local merchant in each town as cashier. This plan had to be abandoned on account of the difficulty met in tracing errors to their source. Local collectors were the next resort, but experience soon showed that as a rule they went after only the customers whose accounts were most easy to collect and somebody from the office had to follow them up. Next a bank or other local representative in each region was charged with the task of having all bills on file and of mailing cards to each customer giving the amount of the bill and designating the place where it should be paid. This plan, like the others, failed to prevent an exasperating number of errors.

Finally, the somewhat radical scheme was inaugurated of encouraging the payment of bills by check and sending out a combination form comprising the bill and a blank check. Experience has shown that the method leads straight to the desired end. When it was first tried occasional visits had to be made to customers who failed to comprehend the advantages of making a bank deposit at least sufficient to cover their electric bills. Eventual results have been very gratifying, and although a few customers prefer to send money, the return envelope is sufficiently stout to permit this to be done at their risk. Perhaps the plan of paying by check would not work out well in all communities, but in this steady-going and conservative Southern territory it seems to answer admirably.

Inefficient Stations Have Been Supplanted by Such as These

GROUPING the service to 500 communities under a single management has permitted shutting down or placing on reserve many obsolete stations. A few stations which have supplanted older ones in the territory served by the Middle West Utilities Company are shown. A is the Boelus (Neb.) station of the Central Power Company. B is the Prairie du Sac (Wis.) station of the Wisconsin River Power Company. C is the generator hall of the Williams plant of the Southern Indiana Power Company. D and E are steam-generating stations at Pocket, Va., and Muddy, Ill., respectively. F is the Southern Wisconsin Power Company's Kilbourn plant.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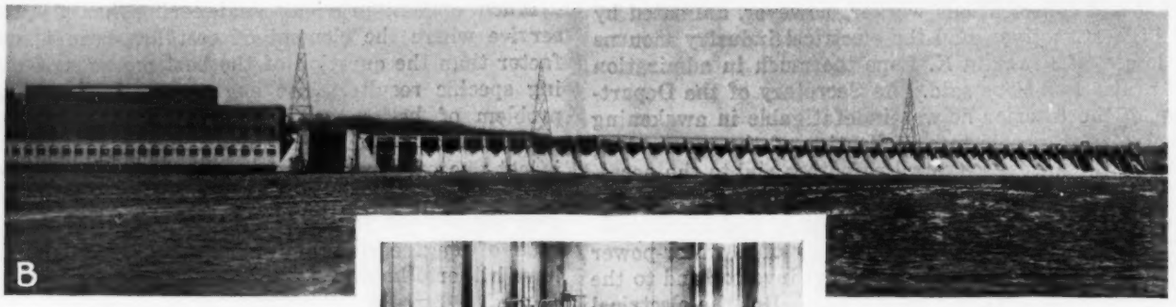
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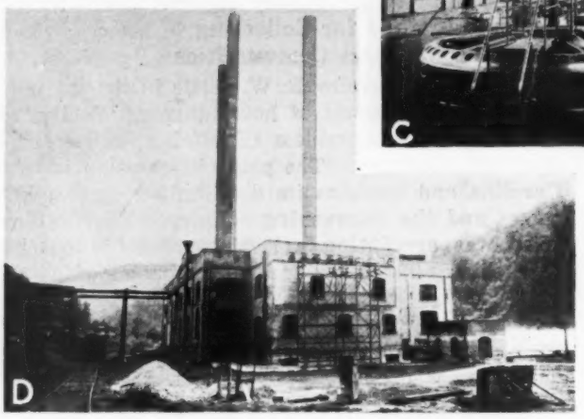
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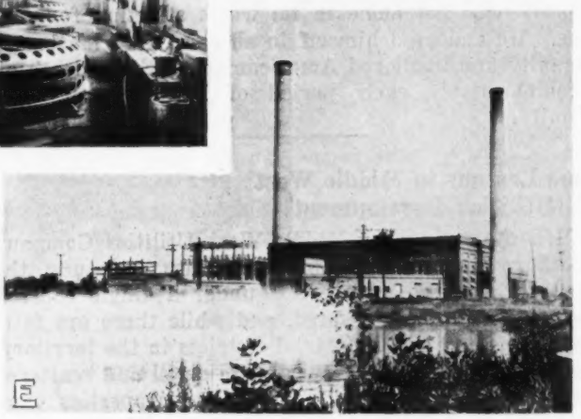
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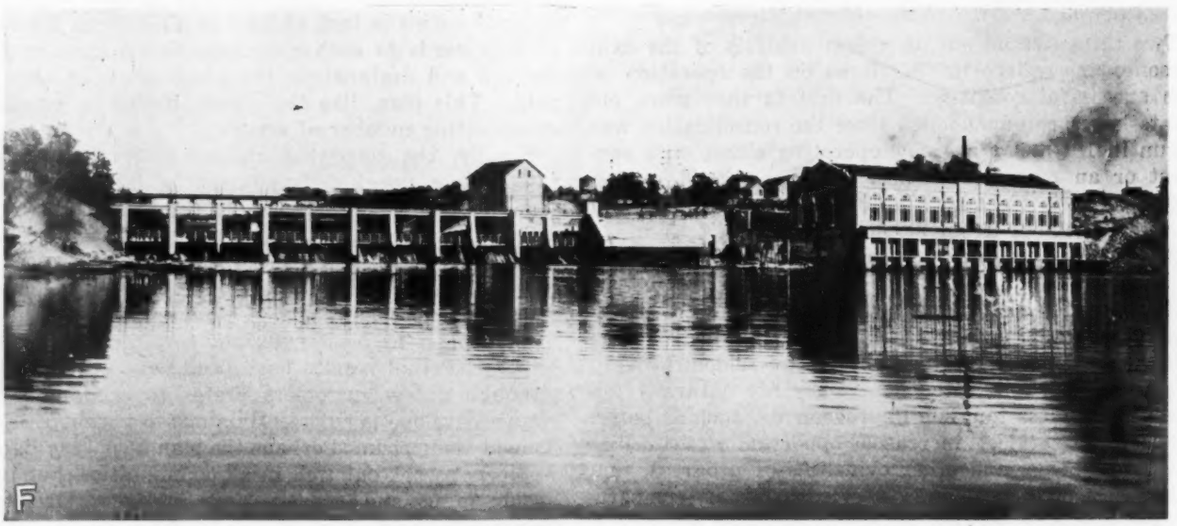
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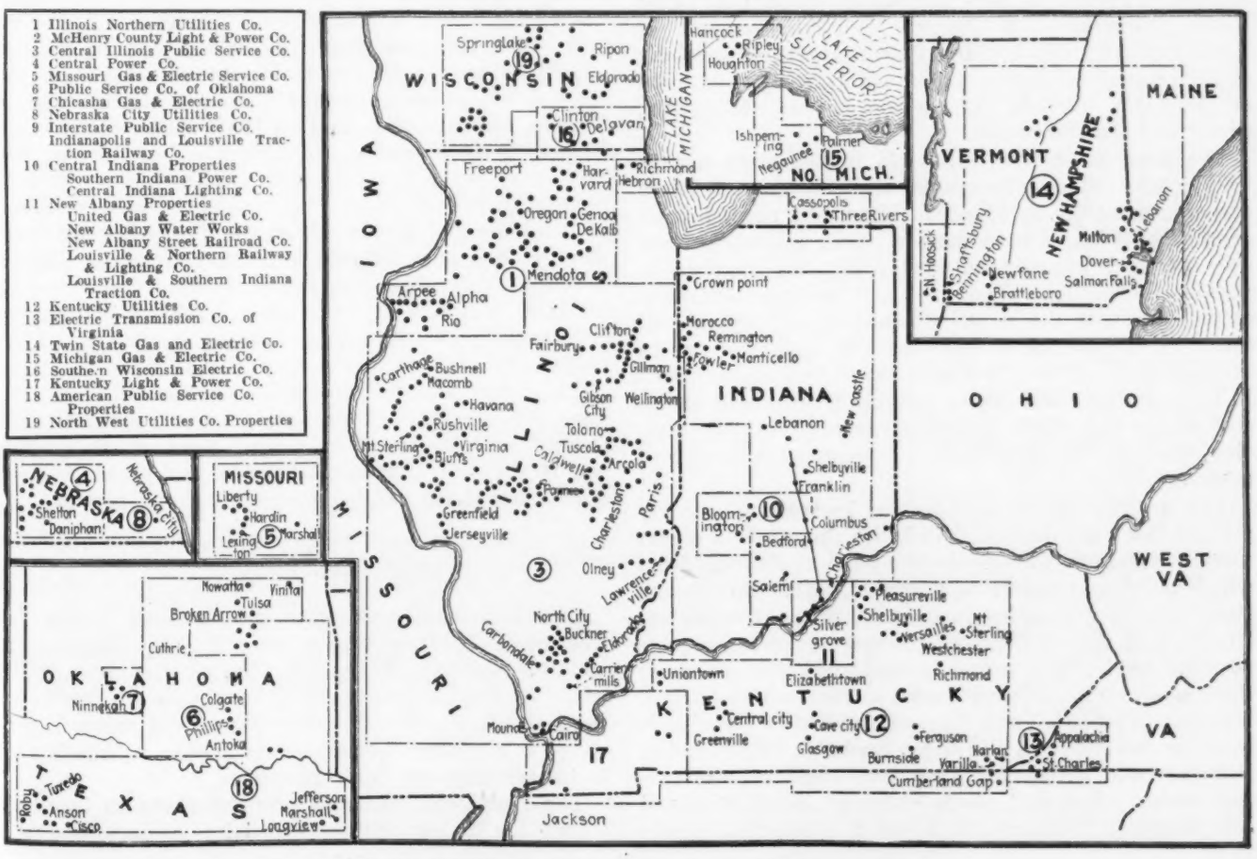
Improved Service to 500 Communities

Physical Features of Middle West Utilities Properties that Under Leadership of Martin J. Insull, President of the N. E. L. A., Have Bettered Service by Eliminating Inefficient Plants — Service Furnished in Fifteen States

THE task of operating all classes of public utilities in more than 500 communities in fifteen states involves an array of financing, operating and commercial problems that fascinate the true central-station operator. The supply of service under such conditions and the honor of contributing to the comfort of humanity in all walks of life can be justly claimed by the Middle West Utilities Company. Its power is depended on in Texas and Oklahoma for operating cotton gins and in New England for cotton spindles. In the Middle West, South and Southwest coal is mined by the aid of its power, and in the upper peninsula of Michigan the mining of iron ore is dependent on its power supply. The overflow lands along the Illinois River are reclaimed and the thirsty soil of the Platte Valley is irrigated by pumps whose source of power is the plants of the Middle West Utilities constituent properties. The building stone of Indiana and the lumber of many states use its power as they pass into industrial service. The grain of the great corn and wheat belts, the oil of the mid-continent fields and the farms of the great Wisconsin dairy country all have their claim upon the activities of this company.

In addition, every imaginable type of factory depends upon the ability of the Middle West organization to maintain its service. People are carried to and from work, aid is given in maintaining evening amusements, the merchants' display of wares is facilitated, the streets, the home and the office are lighted, food is cooked, and the thousand and one labor-saving devices that have accomplished so much in making life worth living are made possible by the activities of this extensive organization.

The spread of operations is clearly shown in the nineteen groups (below) that compose the principal subsidiary companies. An important feature of the physical characteristics of the system is the manner in which the small cities and towns form compact groups. The groups have been acquired and developed with special regard to the sources of power that could serve a given district and the industrial requirements that would utilize these power sources. The organization has been so well worked out that the electrical energy from which 60 per cent of the company's revenue is derived finds its chief market in the compact groups of small cities and towns just referred to. Where water power is available and fuel resources are distant water power is chiefly used. Where no water power is available the generating plants are built at or near the fuel supply. In Kentucky and Virginia and the Middle West steam plants are situated at the mine mouth, while in the Oklahoma and Texas groups the



TERRITORY SERVED BY THE MIDDLE WEST UTILITIES COMPANY

plants are designed to use oil or gas, either of which is produced on the spot.

Approximately 3,900 miles (16,300 km.) of transmission line of varying voltages tie in the towns of the various groups with their generating stations and substations and with each other. Table I gives the communities served, the various classes of service and the estimated population reached. The principal groups of properties and the territories which they serve are as follows:

TWELVE PLANTS HAVE SUPPLANTED EIGHTY-EIGHT INSUFFICIENT ONES IN ILLINOIS

Virtually the entire State of Illinois, with its varied industries springing from agriculture, coal mines and oil wells and the industrial plants that cluster around fuel sources, forms the scene of operations of one subsidiary—the Central Illinois Public Service Company. Two principal offices, Springfield and Mattoon, handle the entire operation of this property, which is divided into four main units with headquarters at Mattoon, Marion, Beardstown and Gilman.

Twenty-nine towns in the rich agricultural districts of northeastern Illinois are served chiefly from the station at Watseka, while standby plants are maintained at Paxton and Hoopeston. A transmission line from Fairbury to Pontiac connects the division with the Public Service Company of Northern Illinois, from which power is purchased. A transmission line from Sheldon east also ties into the transmission lines of the Interstate Public Service Company.

In the east central portion of the state are communities that include a larger number of electric, gas and heating customers than any of the others. These obtain power largely from the steam plant at Kincaid. Power is also purchased from the Terre Haute, Indianapolis & Eastern Traction Company at Paris and from the Indiana Power & Water Company at Vincennes. Standby steam plants are maintained at Mattoon, Tuscola, Charleston, Paris, Effingham, Olney and Lawrenceville.

The most productive oil fields in the state are in the vicinity of Lawrenceville and Robinson. There are approximately 8,000 producing wells, requiring an average of 3 hp. each to operate. Only a small portion are operated by electric power, but the number is rapidly increasing. The company transmission lines extend through the most productive part of the oil territory and are the logical source of power for future developments. Power is furnished to two oil refineries in Lawrenceville and one in Robinson. Railroad shops, coal mines and other industries grouped in this division draw on the lines of the company as a source of power.

The wealthy agricultural section in the west central part of the state depends chiefly on the Kincaid steam plant and the great hydro-electric plant at Keokuk, from which purchased power is available, although standby steam plants are maintained at Havana, Beardstown, Virden and Jerseyville. Sixty-three communities are served. Agriculture is the dominant industry, although there are coal mines near Auburn, Thayer and Girard. Macomb, White Hall and Colchester boast of large clay-working plants, and Havana, Bushnell, Beardstown, Pittsfield and Jerseyville have good-sized manufacturing plants. Railroad shops exist at Roodhouse and Beardstown. Grain elevators are a substantial source of power demand in this division. This division also furnishes power to central pumping stations for the drainage of about 60,000 acres flooded by the construction of the Chicago Drainage Canal.

The richest coal deposits in Illinois lie in the southern portion of the state. Many of the mines and twenty-two communities in the heart of that region obtain electric power principally from the company's steam station at Muddy. This is the largest steam station on the entire properties of the Middle West Utilities Company and is located about 3 miles (4.8 km.) south of Harrisburg. The generating plant operated at Mounds in connection with an ice plant having a capacity of 200 tons a day that furnishes nearly its entire output to the Illinois Central Railroad for icing refrigerator cars is also an important source of supply. Standby plants are maintained at Carbondale and Anna.

Sixty per cent of the coal output of the state is from mines in the vicinity of the company's lines. Of the total mining load 20 per cent is carried on the company's lines. The majority of the new mines purchase their entire power requirements, and the older mines are gradually changing over by installing motor-generator plants to furnish all their power or assist their own small direct-current plants. Power demands from oil wells, railway terminals, clay-working plants, canning factories and grain elevators help to diversify demands and prevent violent fluctuations. The most striking example of the effect of this diversity lies in the demand for drainage pumping power in the spring and summer months when the coal-mine demand is lightest, while during the remaining months the drainage power demand is light, with a heavy demand from the coal mines.

The dairy and corn belt in the northwestern section of Illinois is served by the Illinois Northern Utilities Company, sixteen counties being included in its territory. The principal steam generating plant is the one at Dixon, and there are hydro-electric plants on the Rock River, at the government dam at Sterling and at Oregon, also at Dixon and on the Pecatonica River at Freeport. Other plants are maintained at Geneseo and Belvidere, the latter a standby plant, while power is purchased at Aledo from the People's Power Company, at Belvidere and Mendota from the Public Service Company of Northern Illinois, at Fulton from the Clinton Gas & Electric Company, and at Sterling from the Dillon Mills, a local industrial establishment. Rural service is a feature of the company activities, and manufacturing activities lend diversity to the demand.

The maps best tell the story of transmission voltages for the Illinois groups, 33 kv. predominating, though 8 kv. and 16 kv. are much used on the properties in the central part of the state and 13 kv. is used quite extensively on the northern Illinois group.

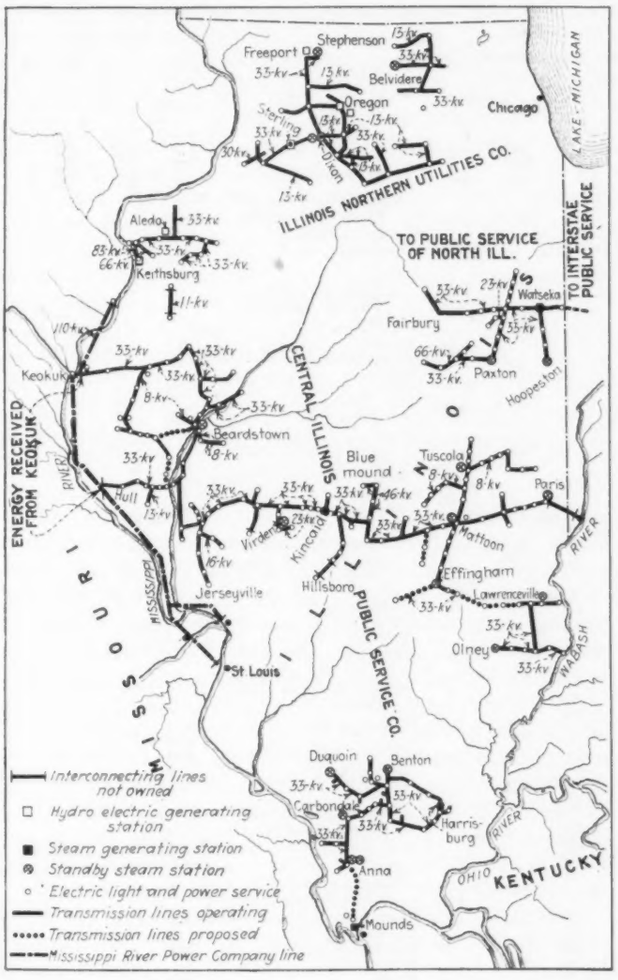
HYDRO-ELECTRIC SUPPLY PREDOMINATES ON WISCONSIN PROPERTIES

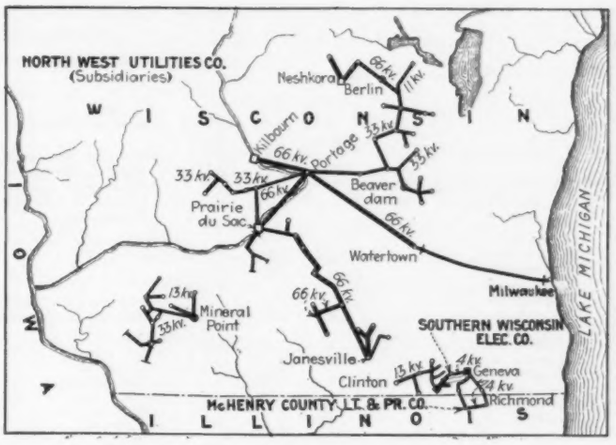
The Wisconsin properties are grouped under the Northwest Utilities Company, a holding corporation, and the Southern Wisconsin Electric Company. The latter centers around Lake Geneva, one of the noted summer resorts of the Middle West, and serves a territory in southern Wisconsin and northern Illinois rich in its farming and dairy resources.

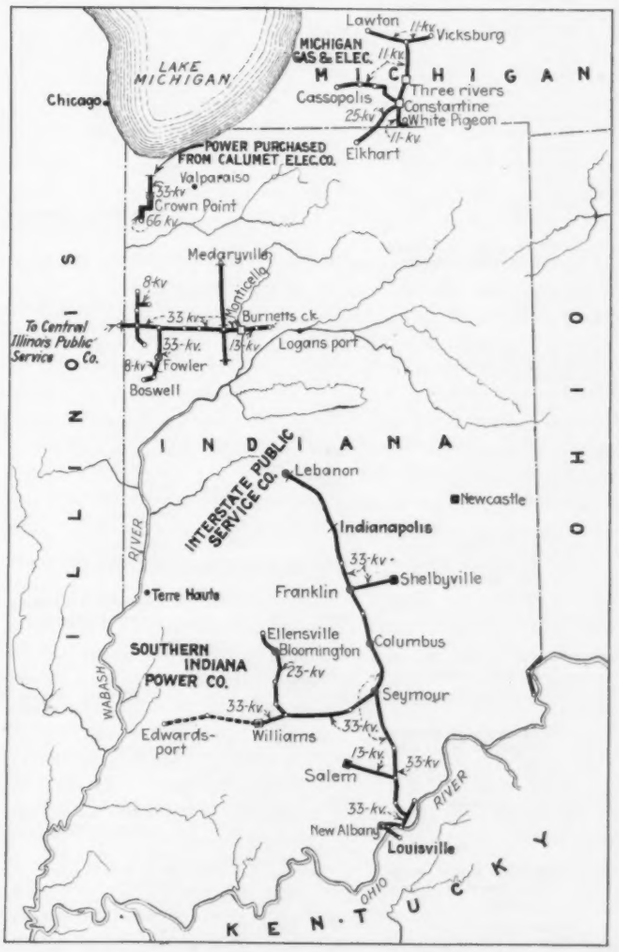
The Northwest Utilities properties are in territory known for its agricultural and dairy products and also

fortunate in the possession of zinc, iron ore and granite resources. Hydro-electric power supply predominates, the Wisconsin River Power Company's Prairie du Sac plant on the Wisconsin River and that of the Southern Wisconsin Power Company at Kilbourn being the main plants. The Prairie du Sac plant is the largest hydro-electric plant among the Middle West Utilities Company properties as well as the largest generating plant. Part of the generation at the Prairie du Sac plant is 25-cycle, a frequency-changer station at Portage tying the 25-cycle and 60-cycle systems together. Generating plants are maintained at Beaver Dam, Neshkora, Berlin, Kingston and Mineral Point, all except Neshkora being standby plants. Power is purchased from the Interstate Light & Power Company for the Mineral Point group, and also at Baraboo from the city. Other purchased power is on an intercompany basis to get the benefit from the two large hydro-electric stations. Wholesaling of energy to central stations in the territory is a feature of the business of the group, the utilities at Madison and Milwaukee being among the customers. The Wisconsin group also has a higher transmission voltage than any other of the groups.

The Indiana properties fall into one large and three small groups operated by the Southern Indiana Power Company and the Interstate Public Service Company.







THE MIDDLE WEST GROUP OF PROPERTIES ARE MOST HIGHLY DEVELOPED FROM AN INTERCONNECTION VIEWPOINT

What Happened When Small Properties Were Grouped Under a Single Management

The number of abandoned stations in the Middle West Utilities Company's system is nearly 50 per cent greater than the number of present operating and standby stations and more than twice as great as the number of stations in continuous operation.

Of 270 stations (including past and present) 156 which were inefficient and inadequate have disappeared and only the better class remain. This change not only has brought about improved service but it also means longer hours of service to communities that could not support twenty-four-hour service except through interconnection with other properties. The operating stations represent in general the best that the territory contains and an average level of efficiency that is well above that which can be attained without interconnection through the maintenance of numerous small plants. This tabulation does not include the stations shut down, for which see Table II.

TABLE I—OPERATING AND STANDBY STATIONS OF THE MIDDLE WEST SUBSIDIARIES, AND OPPORTUNITIES FOR PURCHASING POWER

(Figures in boldface type indicate hydro-electric rating)

Location of Station	Rating (kw) Operating Station	Standby Station	Purchased Power
Central Illinois Public Service Company:			
Anna	.....	480	.....
Charleston	.....	230	.....
Beardstown	.....	900	.....
Christopher	.....	.....	1,875
Carbondale	.....	450	.....
Effingham	.....	500	.....
Fairbury	.....	.....	1,500
Hulls	.....	.....	7,500
Havana	.....	367	.....
Hoopeston	.....	750	.....
Jerseyville	.....	175	.....
Keokuk	.....	.....	2,500
Kincaid	6,000	.....	.....
Lawrenceville	.....	725	.....
Lawrenceville	.....	.....	1,500
Mattoon	.....	1,581	.....
Mounds	675	.....	.....
Mounds	.....	.....	225
Muddy	15,000	.....	.....
Olney	.....	435	.....
Paris	.....	650	.....
Paris	.....	.....	600
Paxton	.....	450	.....
Robinson	.....	400	.....
Roseville	.....	.....	75
St. Elmo	75	.....	.....
Tuscola	.....	550	.....
Virden	.....	240	.....
Watseka	1,750	.....	.....
Illinois Northern Utilities Company:			
Aledo	.....	.....	500
Belvidere	.....	440	.....
Belvidere	.....	.....	900
Dixon	6,000	.....	.....
Dixon (hydro)	**300**	.....	.....
Freeport (hydro)	**400**	.....	.....
Freeport	.....	1,375	.....
Fulton	.....	.....	100
Geneseo	250	.....	.....
Mendota	.....	.....	600
Oregon	600	.....	.....
Sterling (hydro)	**1,500**	.....	.....
Sterling	.....	300	.....
Sterling (hydro)	**200**	.....	.....
Sterling	.....	.....	300
Northwest Utilities Subsidiaries—Southern Wisconsin Power Company:			
Kilbourn (hydro)	**6,000**	.....	.....
Wisconsin River Power Company:			
Prairie du Sac (hydro)	**25,500**	.....	.....
Wisconsin Power, Light & Heat Co.:			
Baraboo	.....	.....	237
Beaver Dam	.....	550	.....
Neshkora (hydro)	225	.....	.....
Berlin	.....	1,780	.....
Kingston	10	.....	.....
Mineral Point Public Service Company:			
Mineral Point	.....	3,000	.....
Mineral Point	.....	.....	4,500
Northern Wisconsin Electric Company—McHenry County Light & Power Company:			
Lake Geneva and Delevan	.....	.....	1,000
Interstate Public Service Company:			
Aurora	.....	100	.....
Aurora	.....	.....	600
Bloomington	.....	475	.....
Campbellsburg	50	.....	.....
Corydon	110	.....	.....
Crown Point	.....	.....	450
Crown Point	.....	240	.....
Columbus	.....	1,250	.....
Fowler	.....	465	.....
Franklin	.....	400	.....
Indianapolis	.....	.....	3,500
Lebanon	.....	.....	600
Lebanon	.....	800	.....
Monticello (hydro)	**400**	.....	.....
New Castle	1,125	.....	.....
New Albany	.....	1,000	.....
New Albany and Jeffersonville	.....	.....	7,850
Seymour	.....	550	.....
Shelbyville	1,225	.....	.....
Southern Indiana Power Company:			
Williams (part hydro)	4,000 **4,000**	.....	.....
Kentucky Utilities Company:			
Central City	150	.....	.....
Cynthiana	390	.....	.....
Elizabethtown	250	.....	.....
Franklin	260	.....	.....
Glasgow	287	.....	.....
Greenville	.....	105	.....
Mount Sterling	.....	200	.....
Mount Sterling	.....	.....	450
Morganfield	300	.....	.....
Richmond	275	.....	.....
Shelbyville	450	.....	.....
Somerset	950	.....	.....
Varilla	3,000	.....	.....
Versailles	.....	.....	225
Winchester (gas engine)	.....	300	.....
Electric Transmission Company:			
Pocket	6,000	.....	.....
Kentucky Light & Power Company:			
Fulton	255	.....	.....
Hickman	225	.....	.....
Princeton	405	.....	.....
Public Service Company of Oklahoma:			
Atoka	1,000	.....	.....
Broken Arrow	.....	205	.....
Guthrie	.....	712	.....
Guthrie	.....	.....	500
Nowata (gas engine)	475	.....	.....
Tulsa	6,000	.....	.....
Vinita	975	.....	.....
Chickasha Gas & Electric Company:			
Chickasha (hydro)	**975**	.....	.....
Chickasha	955	.....	.....
American Public Service Subsidiaries:			
Abilene	875	.....	.....
Abilene, new station	2,000	.....	.....
Baird	.....	190	.....
Cisco	550	.....	.....
Fort Towson	75	.....	.....
Henryetta	1,500	.....	.....
Hugo	1,035	.....	.....
Longview (Diesel engine)	.....	200	.....
Marshall	1,405	.....	.....
Okmulgee	1,700	.....	.....
Stamford	.....	600	.....
Tulsa	10,000	.....	.....
Missouri Gas & Electric Service Company:			
Lexington	.....	562	.....
Liberty	.....	250	.....
Liberty	.....	.....	1,000
Marshall	650	.....	.....
Richmond	.....	462	.....
Central Power Company:			
Boelus (hydro)	2,000	.....	.....
Kearney (part hydro)	750 **900**	.....	.....
Grand Island	2,250	.....	.....
Nebraska City Utilities Company:			
Nebraska City	850	.....	.....
Twin State Gas & Electric Company:			
Brattleboro (hydro)	700	.....	.....
Brattleboro	.....	.....	525
Bennington (hydro)	**400**	.....	.....
Bennington	.....	.....	2,250
Berlin	1,850	.....	.....
Dover	2,250	.....	.....
Dover	.....	.....	2,000
Farmington (part hydro)	**75**	175	.....
Hoosick Falls (hydro)	**500**	.....	.....
Milton Mills (hydro)	**250**	.....	.....
St. Johnsbury	.....	.....	300
St. Johnsbury (hydro)	**875**	.....	.....
St. Johnsbury (hydro)	**200**	.....	.....
St. Johnsbury (hydro)	**400**	.....	.....
St. Johnsbury (hydro)	**100**	.....	.....
St. Johnsbury (hydro)	**240**	.....	.....
St. Johnsbury (part hydro)	**187** **625**	.....	.....
Berwick & Salmon Falls Electric Company:			
South Berwick (hydro)	**1,200**	.....	.....
Michigan Gas & Electric Company:			
Constantine (hydro)	**1,950**	.....	.....
Constantine	.....	.....	2,000
Ishpeming	1,700	.....	.....
Ishpeming	.....	.....	600
Three Rivers (hydro)	**120**	.....	.....

The larger group, consisting of the Interstate Public Service properties, lying mainly between Indianapolis and Louisville, Ky., and connected with the Southern Indiana Power Company's lines by a 33-kv. transmission line between Seymour and Bedford, furnishes power to the limestone quarries, coal mines and industrial plants between Indianapolis and Louisville and is largely concerned with the operation of the successful interurban railway between Indianapolis and Louisville. Power is furnished this group from the combined hydro-electric and steam plant at Williams and the steam plants at Shelbyville, New Castle, Campellsburg and Corydon. Transmission lines on these properties are mainly 33 kv. The line between Indianapolis and Louisville has only recently been reconstructed and raised to this voltage.

Power is purchased from the Louisville Gas & Electric Company, the Merchants' Light, Heat & Power Company at Indianapolis and from the Cincinnati Traction Company at Cincinnati for the small group of properties around Aurora and Rising Sun.

Two of the smaller groups are in northwestern Indiana, one covering Lowell and Crown Point, the Gretna Green of the Chicago territory. Power is purchased from the Calumet Electric Company, and a standby steam plant is maintained at Crown Point.

The larger of the two groups is served mainly from the hydro-electric plant at Monticello and also through the connection with the Central Illinois Public Service Company; 33-kv. transmission rules in this group.

COAL MINES OF KENTUCKY AND VIRGINIA ARE LARGE POWER USERS

These properties cover a large agricultural region in central Kentucky, including ten counties of the "blue-grass" region. The properties of southeastern Kentucky and western Virginia are in a rich mining region. Seventy-five per cent of all the coal-mining operations in Bell and Harlan counties, Ky., and Lee and Wise counties, Va., are supplied with power by the Kentucky Utilities, and through the wholesaling of power to the Old Dominion Power Company the mining operations around Norton, Va., also receive power from this system. Ten operating steam-electric stations are maintained in the state and one in Virginia. That at Pocket, Va., is the largest and the Varilla station is next largest, the two being rated at 6,000 kw. and 3,000 kw. respectively. Three standby stations—one gas-engine-driven—are maintained, and power is purchased at Mount Sterling and Versailles from the Lexington Gas & Electric Company.

The tendency of the average individual will be to wonder where the advantages of grouping such properties as these may be found. In the comparative sense there are no generating stations that are large. Transmission-line practice, judged by the methods followed in some sections of the country, are not at all spectacular. The mental tendency always to dwell on the property of huge proportions and spectacular equipment leads to decidedly erroneous conclusions in a case of this kind. An indication of the facts will be furnished by a study of Tables I and II, which shows in a very striking way the effect of this property grouping on plant operation. To arrive at the true meaning of this table it must be clearly realized that these properties are not serving a single, compact, highly developed territory. Their mileage of transmission lines and number of consumers served do reach an impressive total, but the territory served covers a tremendous area of the United States. While the individual groups are compact, the property as a whole is widely scattered.

WHAT PROPERTY GROUPING MEANS

The physical result of the combination has been the elimination of more than twice as many plants as are now in constant operation. Since standby plants are largely non-operating plants, the practical effect has been the elimination of more than the 156 plants absolutely closed down, since at least some among the forty-two standby plants are, from an operating standpoint, in the saving of labor and fuel expense, equivalent to abandoned plants. It is safe to assume that the equivalent number of plants closed down is approximately two and one-half times the number of plants now serving the properties. When it is remembered that the nature of the territories served is such that the abandoned plants are all small, extremely inefficient and many of them of the type that gave only night service, the gain to the communities in adequate service, better rates and consequent improvement in community conditions can be well appreciated.

A more significant turn is given to the figures when they are analyzed in detail. The Illinois group, which is the most compact of the whole, has twelve operating plants against eighty-eight closed down and nineteen partially operating plants. More than seven times as many plants as are now in constant operation have been closed down completely. The Wisconsin group, with four operating and three standby plants, has closed down eleven stations, while Indiana, with six operating and nine standby stations, has closed down sixteen stations. The other groups are not nearly so compact, and the result is shown in the comparatively small number of generating stations closed down.

TABLE II—HOW INEFFICIENT MIDDLE WEST UTILITIES STATIONS HAVE BEEN SUPERSEDED

	Stations Operating	Standby Stations	Stations Closed Down	Total Stations	Sources of Purchased Power
Illinois:					
Central Illinois Public Service Co.	5	16	62	83	7
Illinois Northern Utilities Co.	7	3	26	36	4
Wisconsin	4	3	11	18	2
Indiana	6	9	16	31	5
Kentucky	14	3	14	31	1
Oklahoma-Texas	15	4	9	28	1
Nebraska-Missouri	5	3	8	16	1
New England	13	1	5	19	3
Michigan	3	0	5	8	2
Total	72	42	156	270	26

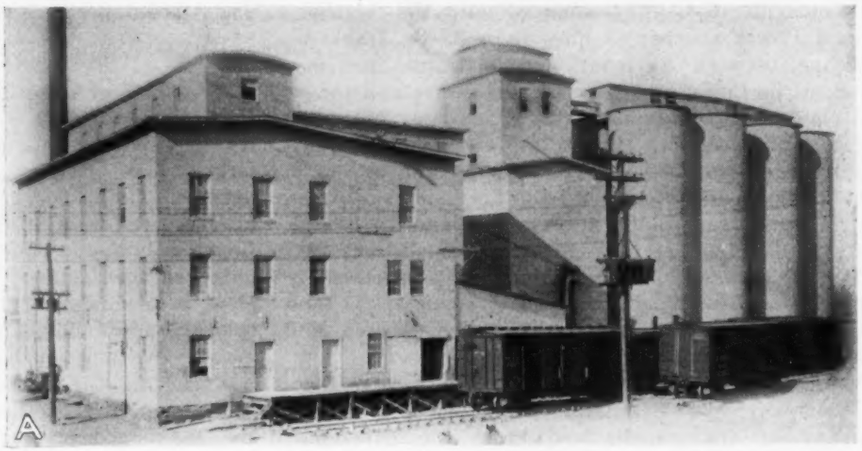
OPPORTUNITIES FOR PURCHASED POWER

Another factor in the closing down of stations has been the ability to purchase power both within the groups and from outside sources. In the Wisconsin group the interconnection of the systems to take power from the Prairie du Sac and Kilbourn hydro-electric plants has aided in preventing the building of numerous small plants to give service to small communities as well as in permitting the shutting down of small, inefficient stations. Illinois leads in the number of sources of purchased power, indicating her possession of a greater number of opportunities to do so advantageously. Indiana is the next state in line in this respect.

The larger part of the total territory served lies where individual communities left to provide their own

Diversified Industries Enjoy Benefits of Electric Service

EVERY imaginable tyne of industry depends on the Middle West Utilities Company for service. A few uses are illustrated. A is a grain mill and elevator at Guthrie, Okla. B is a 30-loaf electric bake oven. C is a pump jack and oil well near Bridgeport, Ill., near where 8,000 wells are located. D is an ice plant at Longview, Tex. E is a part of an Indiana quarry at Bedford. F. shows electric coal mining at Lexington, Mo.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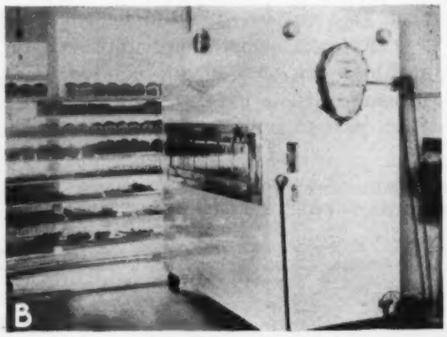
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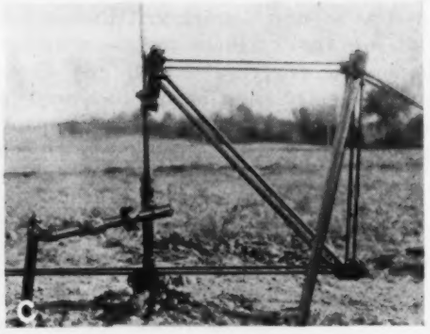
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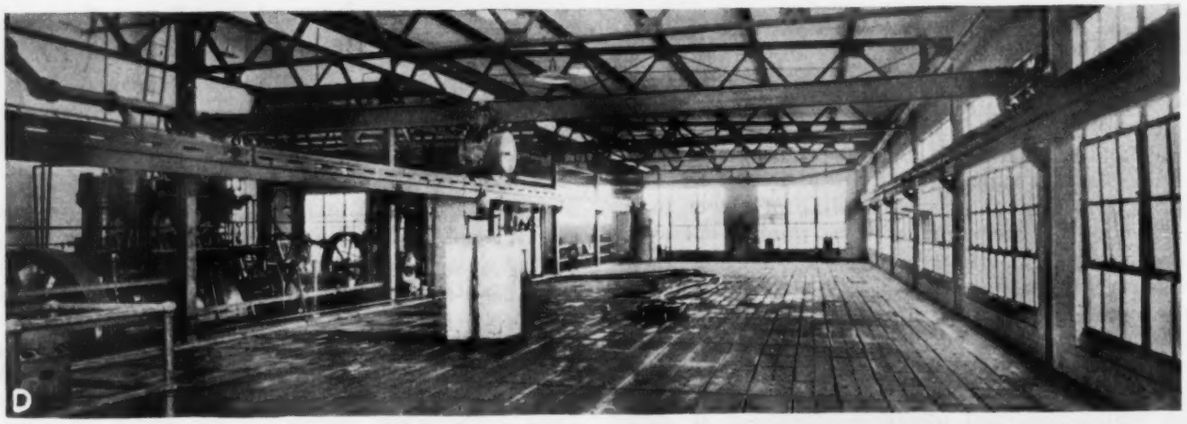

D

E

F

service would be compelled largely to limp along with half service or none at all because of the small individual demands. The territory as a whole would not support the tremendous plants that are found in the highly developed and concentrated industrial districts of Chicago, Pittsburgh and New York districts. The achievement of the Middle West Utilities Company lies in the taking of territory that would otherwise have inadequate service and giving it adequate service by linking up the properties, utilizing the most efficient stations and providing new and efficient ones of adequate size as the needs of the service demand, shutting down inefficient plants and giving service that for the demands of the territory cannot be bettered even in the more highly developed commercial and industrial centers.

Middle West Growth Chiefly in Energy for Power Purposes

Both Connected Power Load and Energy Sales Show Remarkable Growth —Fuel Consumption Reduced by Elimination of Old, Inefficient Plants— Gross Earnings per Capita Increase Nearly Four Times Since 1912

AN INVESTMENT of $125,000,000 in property to provide utility service is a sizable sum even in these days of thinking in huge figures. This represents in round figures the investment in the operating properties comprising the Middle West Utilities Company. Of the total nearly $26,000,000 represents the investment and construction expenditures of subsidiary companies in the six years from 1915 to 1920 inclusive. What this indicates is shown in Table I, in which the classes of service, the communities served and the population dependent on service are given. In terms of population in the territory served the investment per capita reached $93 at the end of 1920. Although these figures cannot be used as an average of the investment necessary under any and all conditions, they are an interesting indication of the investment cost to give service that may have to be considered in any cases under discussion.

Much of the growth of the properties took place during the war years, when the operating and management problems were most acute. The Middle West Utilities Company was organized May 15, 1912, and therefore except in the first two years of its existence it has always had to face war problems, originally those that arose before the United States was actually engaged in the conflict, and later those incident to our active participation in the war and to the reconstruction period that is still painfully present.

TABLE I—GROWTH OF MIDDLE WEST UTILITIES COMPANY FROM APRIL 30, 1916, TO DECEMBER 30, 1920*

Subsidiary Companies	State	Number of Communities Served		Different Classes of Service												Estimated Population Served	
				Electric		Gas		Water		Ice		Heat		Railway			
		1916	1920	1916	1920	1916	1920	1916	1920	1916	1920	1916	1920	1916	1920	1916	1920
Central Illinois Public Service Co	Ill.	164	186	163	185	6	8	11	13	14	14	13	7	6	7	285,000	355,000
Illinois Northern Utilities Co	Ill.	60	72	58	70	9	9	..	..	1	..	3	1	2	2	132,200	135,900
Sterling, Dixon & Eastern Elec. Railway Co	Ill.																
McHenry County Light & Power Co.[1]	Ill.	..	2	..	2	..	..	..	..	..	..	..	..	..	..	.....	1,500
Interstate Public Service Co	Ind.	24	27	21	26	5	7	4	6	4	..	4	1	1	2	82,300	93,000
Indianapolis & Louisville Tractn. & Ry. Co.[2]	Ind.																
Southern Indiana Power Co	Ind.	3	3	3	3	..	..	..	..	..	..	..	..	..	..	2,500	2,500
Central Indiana Lighting Co	Ind.	2	2	2	2	1	1	..	..	..	..	1	..	1	1	22,000	22,000
Franklin Water, Light & Power Co.[3]	Ind.	1	..	1	..	1	..	1	..	..	..	..	..	..	..	5,600	.....
United Gas & Electric Co	Ind.																
New Albany Waterworks	Ind.																
Louisville & Northern Railway & Lighting Co.	Ind.	8	8	7	8	2	4	2	2	..	..	..	..	3	3	46,900	46,900
Louisville & Southern Indiana Traction Co	Ind.																
Kentucky Utilities Co	Ky.	21	34	21	34	1	1	3	6	5	8	..	..	1	1	61,400	84,000
Kentucky Light & Power Co.[4]	Ky.	..	5	..	5	..	..	..	1	..	1	..	..	..	..	.....	13,900
Electric Transmission Co. of Virginia	Va.	5	5	5	5	..	..	..	..	..	..	..	..	..	..	6,100	6,100
Citizens' Gas Light Co.[5]	Tenn.	..	1	..	..	..	1	..	..	..	..	..	..	..	..	.....	19,600
American Public Service Co.[6]	Okla. Texas	..	22	..	21	..	2	..	1	..	17	..	..	..	1	.....	108,600
Public Service Co. of Oklahoma	Okla.	8	10	8	9	..	..	..	..	4	6	..	..	..	..	53,200	127,500
Chickasha Gas & Electric Co	Okla.	2	3	2	3	1	1	..	..	..	..	..	..	..	..	13,400	13,900
Central Power Co.[7]	Neb.	..	14	..	14	..	1	..	..	..	1	..	..	..	..	.....	27,900
Nebraska City Utilities Co	Neb.	1	1	1	1	1	1	1	1	..	..	..	..	..	..	6,900	6,900
Missouri Gas & Electric Serv. Co	Mo.	9	10	9	10	2	2	..	..	..	1	..	..	..	..	23,500	24,200
Southern Wisconsin Electric Co	Wis.	7	10	7	10	..	..	..	..	..	..	..	..	..	..	11,300	13,500
Northwest Utilities Co.[8]	Wis.	..	33	..	33	..	3	..	1	..	..	..	2	..	..	.....	55,700
Michigan Gas & Electric Co	Mich.	9	16	9	13	3	6	..	..	..	..	..	..	1	1	38,200	60,200
Twin State Gas & Elec. Co	New Eng.	31	38	31	38	3	3	..	..	..	..	..	..	..	1	107,800	117,400
Berwick & Salmon Falls Electric Co	New Eng.																
Total	.....	355	502	348	492	35	50	22	31	28	48	21	11	16	19	929,00	1,336,200

*Since Dec. 31, 1920, all the properties in Indiana except the Indianapolis & Louisville Railway and the Southern Indiana Power Company have been merged with the Interstate Public Service Company.

[1]McHenry County Light & Power Company organized in 1916.

[2]Indianapolis & Louisville Traction & Railway Company. This property was purchased in 1919.

[3]Franklin Water, Light & Power Company, now included in Interstate Public Service Company.

[4]Kentucky Light & Power Company purchased in 1917.

[5]Citizens' Gas Light Company purchased in 1916.

[6]American Public Service Company purchased in 1917.

[7]Central Power Company purchased in 1917.

[8]Northwest Utilities Company purchased in 1919.

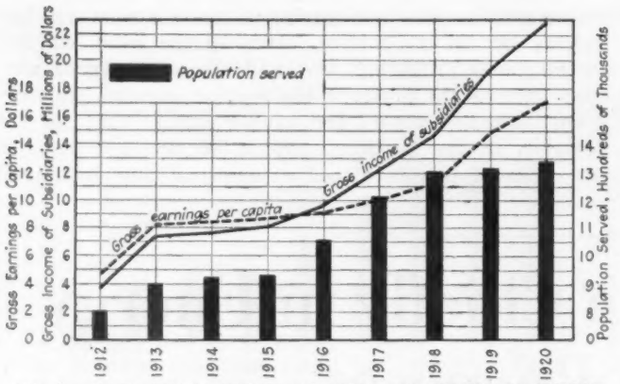


FIG. 1—POPULATION SERVED AND GROSS EARNINGS OF MIDDLE WEST UTILITIES COMPANY SUBSIDIARIES

At the issuance of the first annual report, dated April 30, 1913, when the subsidiary properties had been under the control of the Middle West Utilities an average of nine months, 274 communities, with a population of between 800,000 and 900,000, were being served and the battle for improvement of operating conditions by the interconnection of properties and the replacement of the numerous inefficient and obsolete plants was at its height. In 1914 333 communities in ten states were served. The total increased to the 355 communities shown in Table I for 1916, and through

TABLE II—GROSS INCOME AND GROSS EARNINGS PER CAPITA OF MIDDLE WEST UTILITIES COMPANY SUBSIDIARIES

	Gross Income of Subsidiaries	Population Served	Gross Earnings per Capita
1912	$3,680,676.76	800,000	$4.60
1913	7,345,350.73	900,000	8.15
1914	7,634,745.29	917,000	8.35
1915	8,091,148.62	929,000	8.70
1916	9,620,216.13	1,055,300	9.10
1917	12,157,121.57	1,208,800	10.05
1918	14,641,035.34	1,297,150	11.25
1919	19,362,673.74	1,309,900	14.80
1920	22,729,922.75	1,336,200	17.00

the war and post-war years a steady growth has been maintained.

Something of the story written in terms of gross earnings per capita can be traced in Table II. The $4.60 per capita for 1912 represents about what may be expected from small, inefficient plants with high operating costs and little ability to render attractive service. The improvement in service and growth of facilities to give service can be traced in the increase in earnings per capita, which in 1920 were nearly four times the gross earnings per capita in 1912. These figures also tell their story of education and careful, thoughtful attention to the needs of the population served.

TABLE III—SOURCES OF OPERATING AND GROSS INCOME OF MIDDLE WEST UTILITIES SUBSIDIARIES FOR THE YEAR 1920

	Operating Income	Per Cent of Total
Electric	$13,622,703	67.2
Gas	1,698,676	8.2
Water	530,361	2.6
Railway	2,534,977	12.3
Heat	209,130	1.3
Ice	1,740,576	8.4
Total	$20,336,423	100.0
	Gross Income	**Per Cent of Total**
Electric	$13,622,703	60.0
Gas	1,698,676	7.5
Water	530,361	2.3
Railway	2,534,977	11.1
Heat	209,130	0.9
Ice	1,740,576	7.7
Mercantile	1,977,948	8.7
Miscellaneous non-operating	415,551	1.8
Total	$22,729,922	100.0

The income from electrical sources by years from 1916 to 1920 is shown in Table IV.

ELECTRIC POWER BUSINESS RAPIDLY INCREASING

The total number of consumers served with electrical energy, gas and water now runs to the huge total of 304,658.

The record since 1915 is given in Table V.

The growth of the electrical energy sales from 1916 to 1920 (Table VI) shows a remarkable increase. The total kilowatt-hour sales for 1920 are more than three times the sales for 1916. The most interesting figure, however, is the growth of power demands. In 1916 38 per cent of the connected load was for power purposes. This increased to nearly 50 per cent in 1920. The remarkable feature is the percentage of total sales

TABLE IV—INCOME FROM ELECTRIC ENERGY SALES BY MIDDLE WEST UTILITIES SUBSIDIARIES, 1916-1920

	1920	1919	1918	1917	1916
Commercial lighting	$6,645,906	$5,217,113	$4,006,950	$3,400,533	$2,842,877
Commercial power	3,062,948	2,358,415	1,683,111	1,195,437	1,174,866
Municipal lighting	914,350	873,757	915,361	828,617	747,813
Municipal power	195,776	163,868			
Sales to other public utilities	1,524,061	1,200,659	361,576	259,821	212,671
Wholesale light and power	1,252,130	844,918	643,284	321,442	In com'l pwr
Steam sales and miscellaneous	27,530	28,139	.....	.....	.....
Total	$13,622,703	$10,686,871	$7,670,284	$6,005,850	$4,786,477

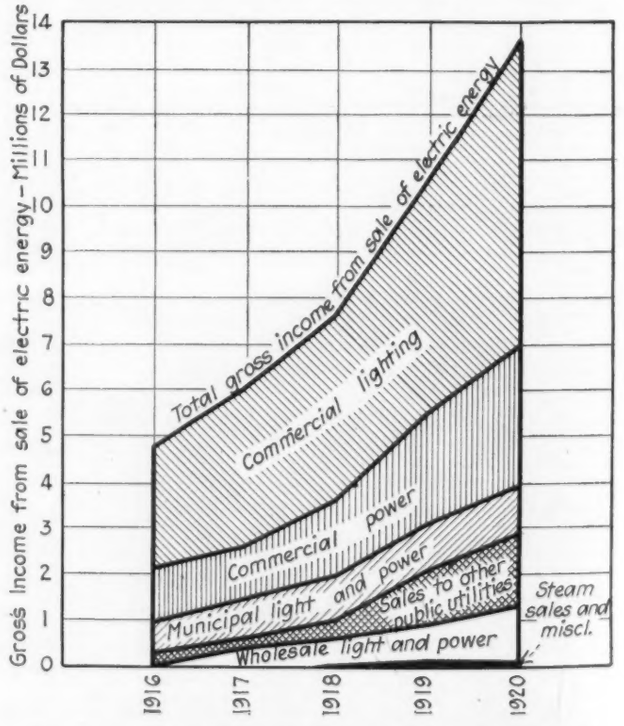


FIG. 2—GROSS INCOME FROM SALE OF ELECTRIC ENERGY BY MIDDLE WEST UTILITIES SUBSIDIARIES

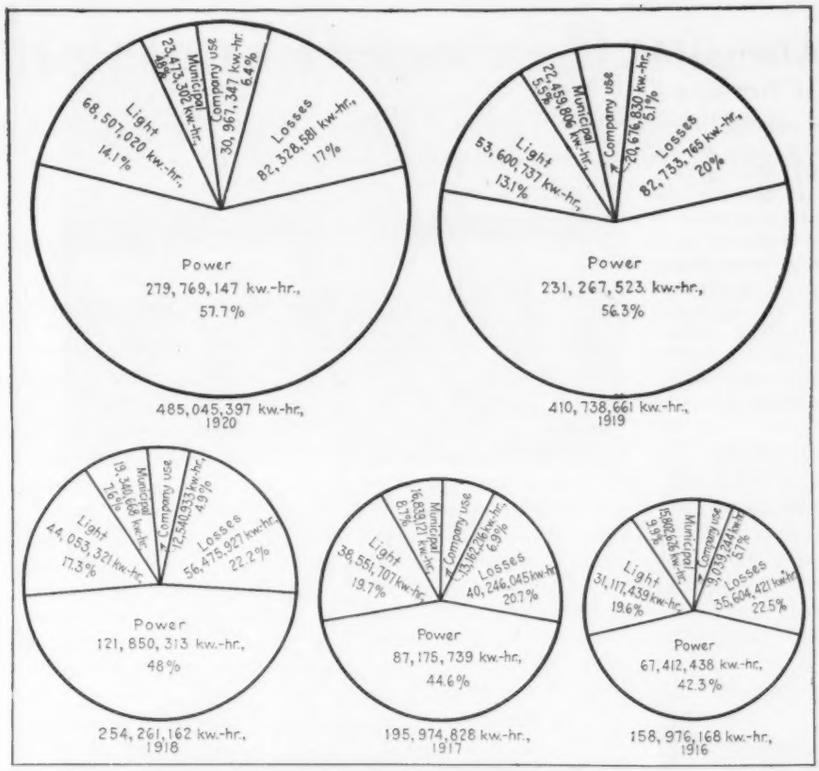


FIG. 3—DISPOSAL OF ENERGY DISTRIBUTED BY MIDDLE WEST UTILITIES SUBSIDIARIES

that are credited to power demands. Whereas it was only 48 per cent of the total in 1916, it had risen to more than 75 per cent of the total in 1920. This is significant of the growth of business in the territory and also of the fact that not only has the organization eliminated inefficient central stations but that it has been instrumental in displacing inefficient industrial plants and in preventing the building of new ones.

TABLE V—ELECTRIC, GAS AND WATER CONSUMERS SERVED BY MIDDLE WEST UTILITIES COMPANIES

Year	Number of Customers Served			
	Electric	Gas	Water	Total
1915	105,571	37,168	14,500	157,239
1916	124,158	39,079	16,097	179,334
1917	143,842	44,782	17,548	206,172
1918	166,051	47,352	20,681	234,084
1919	199,857	52,184	22,300	274,341
1920	226,094	54,500	24,064	304,658

The figures also indicate the direction in which the greatest service to the territory is being performed. Another significant fact is that the margin between energy produced and purchased and the sales, after eliminating company use, has been reduced from 24 per cent in 1916 to a little more than 18 per cent in 1920, pointing toward a material betterment in the adjustment of physical property to operating conditions even during the war years, when the tendency was naturally in the other direction. It is interesting to note that in 1920 190,724,961 kw.-hr., or 39.2 per cent of the total output, both generated and purchased, came from water power.

SECURITIES DISTRIBUTED AMONG SMALL INVESTORS

This movement has only been under way for about a year, having been inaugurated in the spring of 1920. Its remarkable growth is shown by the increase in the number of stockholders from 6,063 and 6,902 on Dec. 31, 1918, and December, 1919, respectively to 10,491 on Dec. 31, 1920, these stockholders holding securities of Middle West Utilities and subsidiary companies. The two earlier years showed an average holding per stockholder of 57 and 51.5 shares respectively. At the end of 1920 this figure was 36.8, showing that the securities have been spread among a class of much smaller investors. These figures do not include approximately 4,100 holders of Middle West prior-lien stock, part of this stock being fully and the rest partly paid up.

Four thousand subscribers to preferred and prior-lien stocks of the subsidiary companies who are likewise partly paid up also are not included in the list of figures.

It is interesting to note that in 1915 there were no electric ranges on the properties, whereas 4,271 were being served at the end of 1920. This is an indication of the possibilities of growth that electric cooking holds forth.

Transmission-line mileage has increased two and one-half times since 1915. There were 1,643 miles (2,643 km.) in that year and 3,964 miles (6,376 km.) at the end of 1920. The daily capacity of ice plants at the end of 1920 was 1,590 tons and the storage capacity 22,795 tons. These plants utilize surplus and off-peak power.

Coal burned is no small item. No less than 557,681 tons was utilized in 1917. This increased to 648,334 tons in 1920. The interesting fact regarding fuel is the reduction of average coal consumption for all plants from 8.9 lb. (4 kg.) per kilowatt-hour in January, 1915, to 4.98 lb. (2.2 kg.) in December, 1920. This reduction was made despite the fact that many of the smaller plants that are low in efficiency must be kept running until conditions will permit of further interconnection and the elimination of those plants which are not altogether up to the standard in the matter of fuel economy.

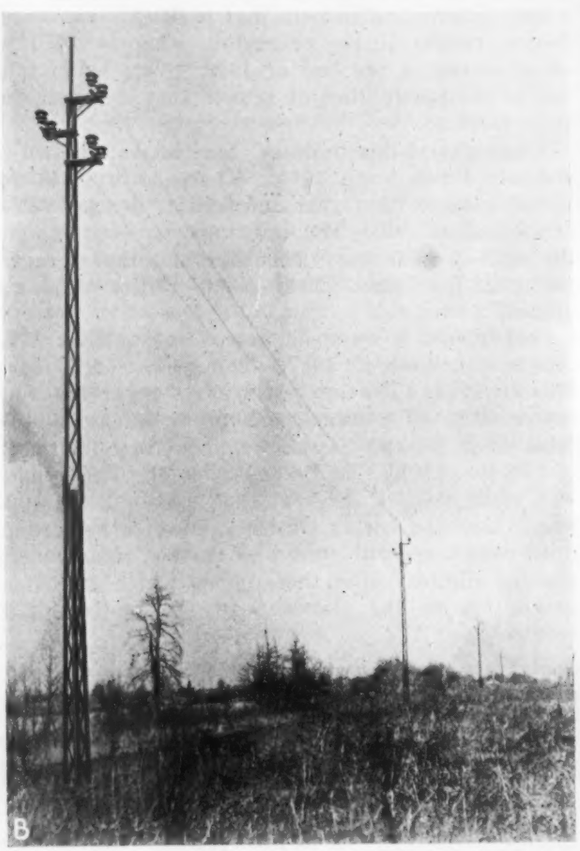
TABLE VI—TOTAL CONNECTED LOAD, POWER LOAD AND ENERGY PRODUCED, PURCHASED AND SOLD BY THE MIDDLE WEST UTILITIES COMPANIES FROM 1916 TO 1920

	Total Energy (Kw.-Hr.)			Disposal of Energy (Kw.-Hr.)						Connected Load	
				Sold to Consumers						Total	Power
Year	Generated	Purchased	Total	Light	Power	Municipal	Total	Company Use	Losses	Kw.	Only (Kw.)
1916	121,166,582	37,809,586	158,976,168	31,117,439	67,412,438	15,802,626	114,332,503	9,039,244	35,604,421	179,871	68,670
1917	145,755,264	50,219,564	195,974,828	38,551,707	87,175,739	16,839,121	142,566,567	13,162,216	40,246,045	219,026	85,103
1918	198,052,900	56,208,262	254,261,162	44,053,321	121,850,313	19,340,668	185,244,302	12,540,933	56,475,927	253,548	104,661
1919	330,027,813	80,710,848	410,738,661	53,600,737	231,267,523	22,459,806	307,328,066	20,676,830	82,733,765	339,066	163,603
1920	373,973,089	111,072,308	485,045,397	68,507,020	279,769,147	23,473,302	371,749,469	30,967,347	82,328,581	385,353	189,448

Interconnection Has Enabled Increased Economy and Reliability of Service

BY TYING together the generating stations in adjacent communities it has been possible to reduce the reserve equipment necessary and also permitted generation of energy in the most economical plants. The lines have permitted giving twenty-four-hour service to rural communities that could not have enjoyed such service otherwise. A is a substation on a large ranch served by the Central Power Company of Nebraska. B and E are tie lines in Illinois between Harrison and Benton, and between Williams and Bedford respectively. C is a transmission line of the American Public Service Company across the Arkansas River near Tulsa, Okla. D is a tie line between Liberty and Missouri City.

A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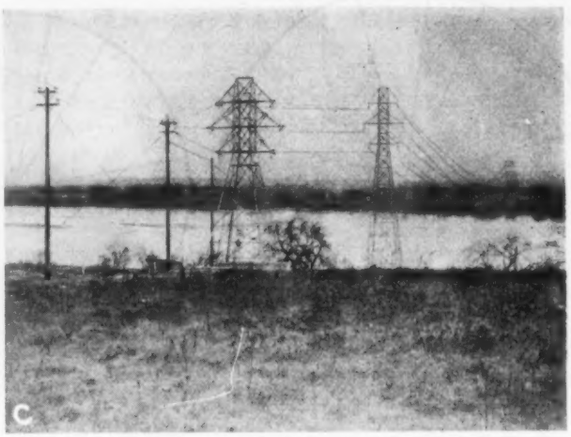
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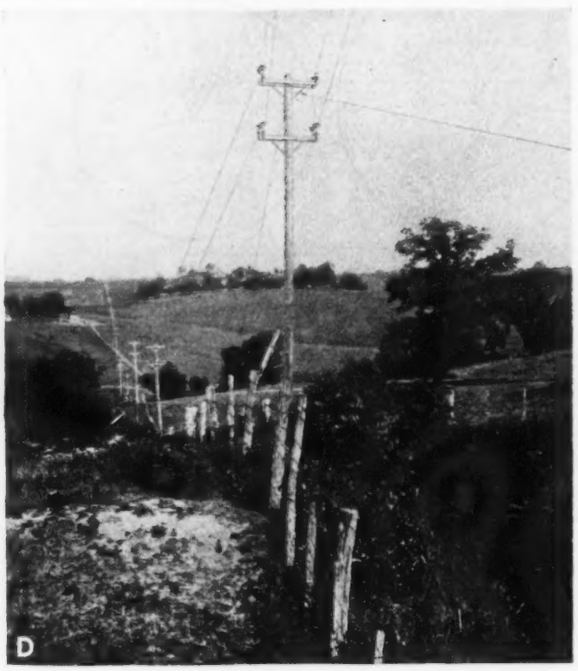
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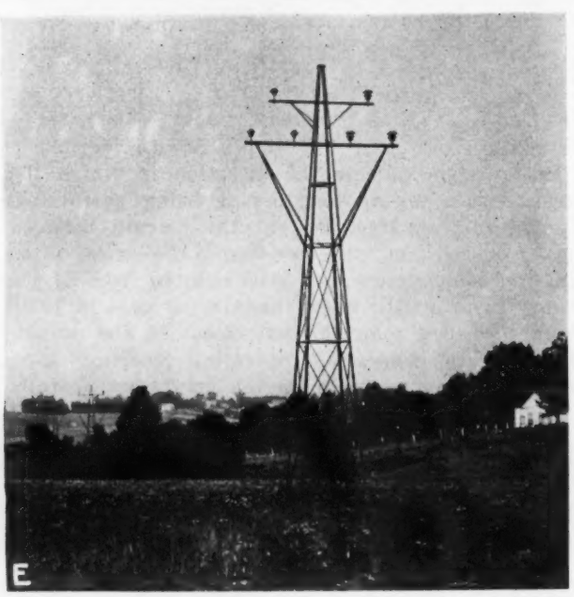
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Relations Between Management and Public

Middle West Utilities Company Maintains The Policy of Making Local Men Real Managers—Commercial Organization Designed to Aid Consumers in Efficient Use of Energy—Rate Schedules Tend Toward Maximum-Demand Basis

THE success of the management of an organization like the Middle West Utilities Company depends on the adjustment of policies to the needs of the communities served. Policies that might be adequate to a property serving a community of equivalent size gathered into a single compact unit would be totally inadequate here because in the main they would be based on the ability of a single community to demand and pay for service that an equal population widely scattered would be totally unable to use.

There are more than five hundred communities in the groups comprising the Middle West Utilities properties. The majority are covered by the Illinois properties, and, close as the grouping in this state is, comparatively, the properties are nevertheless scattered over a wide area. The remainder are distributed over fourteen other states. In the group are cities that support industrial projects of large proportions. Their needs demand the best of specialized skill in the operation of the central station supplying their power requirements. At the other extreme is the community which, left to itself, could command only the barest elements of service, and that for only a few hours of the day. To supply such a community with a service that meets its needs as fully as does the service to the large community involves management problems of no mean proportions, if the allowable cost of service is not to be exceeded.

With such a scattered group of properties there is always the danger of leaning one way or the other in considering the needs of the group as a whole. Consideration and adoption of policies must necessarily be nicely balanced between the two extremes to avoid neglect of either one. The success of these properties and their rapid growth are a testimonial to the ability of the management in successfully avoiding the pitfalls that would mean disaster.

Elsewhere in this issue attention is called to the fact that on these properties old, inefficient plants totaling in effect fully two and one-half times the present number of operating plants have been abandoned. With the increase in the physical efficiency of the properties due to the linking up of the original separate units and the possibility of improving the power supply by increasing the size and efficiency of generating units and utilizing the diversity of demand that must exist in a group of communities there must come a corresponding improvement in the management policies over those that the separate small units could hope to enjoy. Increased service such as that involved in aiding customers in the best and most efficient use of their power supply means an increase in expense that can only be borne up to a certain limit by a single community. Grouping of such communities means the combining of the prices for service that can be afforded until it is possible to provide

Nature of Rate Structures

TABLE I—TYPICAL LIGHT AND POWER RATES

RETAIL

Per Kw.-hr.

12.5 cents for first 30 hours' use, maximum demand
7.5 cents for next 30 hours' use, maximum demand
5.5 cents for over 60 hours' use, maximum demand

When 7.5 per cent and 5.5 per cent portions after prompt payment discount are over $40 there is a discount of 1 per cent to 50 per cent for bills up to $1,000.

Discount—1 cent per kw.-hr. to tenth of month. Minimum 50 cents per hp. per month, or $8 per year per hp.

WHOLESALE

Primary:

Per Kw.

$4.12 for first 50 kw. of maximum demand
3.45 for over 50 kw. of maximum demand

Secondary:

Per Kw.-hr.	Kw.-hr.
8.63 cents for first	1,000
5.24 cents for next	4,000
1.87 cents for next	25,000
1.5 cents for next	70,000
1.35 cents for over	100,000

Discount—10 per cent of secondary to tenth of month. Minimum—$12 per hp. per year for alternating current motors, not less than $22.50 per kw. of demand.

TABLE II—GENERAL COAL-MINING RATE

MONTHLY MAXIMUM-DEMAND BASIS

Primary:

Per kw.

$2.40 for first 200 kw. of maximum demand
1.95 for over 200 kw. of maximum demand

Secondary:

Per kw.-hr.	kw.-hr.
5.3 cents for first	1,000
3.4 cents for next	2,000
2.5 cents for next	2,000
1.7 cents for over	5,000

Discount—10 per cent of secondary charges—ten days. Minimum—$12 per hp. per year. Not to be less than $22.50 per kw. per year of highest monthly maximum demand.

ANNUAL MAXIMUM-DEMAND BASIS

Primary:

Per kw. per year

$28.50 for first 200 kw. of maximum demand, payable at rate of $2.40 per month.
23.35 over 200 kw. of maximum demand, payable at rate of $1.95 per month.

Secondary:

Per Kw.-hr.	Kw.-hr. per Month
6 cents for first	1,000
4.0 cents for next	2,000
3.0 cents for next	2,000
1.7 cents for next	20,000
1.5 cents for next	500,000
1.2 cents for next	1,000,000
1.12 cents for over	1,525,000

Discount—10 per cent of secondary charges—ten days. Minimum—$12 per horsepower per year. Not to be less than $22.50 per kw. per year of highest monthly maximum demand.

Maximum demand to be based on three highest five-minute periods in a month, which once established is to stand for a year. Power factor must be 90 per cent.

TABLE III—COMMERCIAL LIGHTING

Per Kw.-hr.

15 cents for first 30 hours' use of maximum demand
9 cents for next 30 hours' use of maximum demand
6 cents for over 60 hours' use of maximum demand

Discount—1 cent to tenth of month. Minimum—$1 per month.

Sign, Window and Outline—1.8 cents per month per watt connected. Discount—¼ cent per watt to tenth of month.

TABLE IV—DOMESTIC RATES

Residence Lighting:

Per Kw.-hr.

15.5 cents for first 30 hours' use of maximum demand
9.0 cents for over 30 hours' use of maximum demand

Discount—1 cent per kw.-hr. to tenth of month. Minimum—$1 per month. Employees have 50 per cent discount.

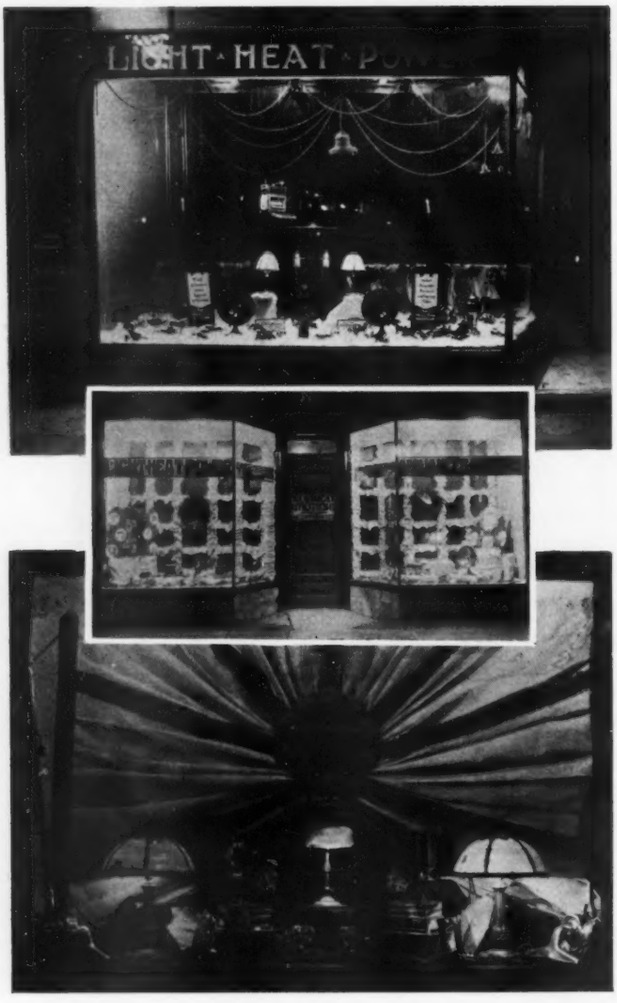
Heating and Cooking:

Per Kw.-hr.	Kw.-hr.
11.7 cents for first	10
3.7 cents for all over	10

Discount—¼ cent per kw.-hr. to tenth of month. Minimum—$24 per year for up to 6,000 watts; $4 per year per each additional 1,000 watts.

for a large group the expert service that until recent years has been possible only in larger and more compact properties.

Commercial policies are of first importance because they deal most directly with the public and determine the success or failure of management. The first important policy of the Middle West Utilities Company lies in the fact that management is local. The community need not look beyond the officials within its own range of view for the handling of the problems that arise. As a result these men become a part of the community life and not mere figureheads through whom the public must deal with some far-off intangible organization thought



TYPICAL WINDOW DISPLAYS WHICH HAVE ATTRACTED BUSINESS

of as a "soulless corporation." This policy lays the foundation for the successful handling of problems because the men in contact with the public have the power to deal finally and effectively on a personal basis with those who know and respect them. These men have the entire resources of the organization at their command for advice and assistance in determining policies that fit specific conditions.

Backed by this policy is a commercial organization so worked out that each group has available the needed expert advisers. These commercial departments may consist of one individual or several as the local needs determine. The aim is to advise customers how their power supply may be used most advantageously. Customers are assisted in selecting the apparatus best suited to their needs. The housewife is instructed in the best methods of using household devices.

One activity of this department consists in co-operation extended to the various domestic-science departments in the public schools. They are advised as to the apparatus best suited to their needs. One important result is the increased use of the electric range and appliances in the communities where this co-operation is extended. The children in the schools, brought to a knowledge of the advantages of the household use of electric appliances, in turn educate the parents.

An item of prime importance in the commercial policy is provision in every office, no matter how small, for an attractive merchandise display. These offices are the most important point of contact with the public. It was found in the smaller properties taken over that oftentimes no attempt had been made to make business offices attractive. In many cases the offices in such properties were in the generating plant and consisted mainly of a desk set down amid unattractive surroundings. A consistent policy of establishing attractive offices has been followed.

Special attention has been given the display windows because they are the first point of contact with the customer who has occasion to visit the office. A favorable impression created by an attractively dressed window and backed by a well-arranged and well-managed office is a vital element in public relations. Such a window and office create the impression of a well-managed and trustworthy concern. The local newspapers are the backbone of the advertising policy. Supplementing this advertising is the window and office display already mentioned. Inclosures with bills are used, and circular letters and similar forms of advertising are employed.

Special campaigns on seasonable appliances are a part of the business policy, though no attempt is made to carry on the same campaign over extended territories. Each community or group is considered on its own merits, and the devices applicable to the local conditions are featured.

A consistent comparison between closely related properties of the results from these commercial activities is carried out, each division or property knowing what has been accomplished elsewhere each month.

Another road to the confidence of the public lies in the possibilities of rural service in the agricultural territory that forms so large a part of the area covered by these properties. The commission rulings in the various states where they are established are followed. Of these the so-called Wisconsin rules (see ELECTRICAL WORLD, Dec. 18, 1920, page 1205) are an important example. Officials of the Wisconsin properties of the Middle West Utilities Company took an important part in the formulation of the rules. Officials of the Illinois groups also took a part in the formation of the Illinois rules established for that state by the commission in December, 1920. The two sets of rules represent the most important practice so far developed in the rural-service situation outside of the combined irrigation and rural service practice of the Western States.

One important practice in rural service followed largely by the Middle West Utilities is to provide the farmer with all apparatus that he can profitably use when service is first established. The farm power equipment, household appliances and wiring, as well as the line and transformer equipment, are included so far as possible in the original proposition, so that proper equip-

ment, safe wiring and a generally successful installation will be provided. The effort in furnishing rural service is not to connect all the business that is offered, but to develop that which is profitable to the consumer and the company on a basis that will make it successful from the start.

No general policy as to loads that will utilize the off-season or off-peak capacity of the plants is possible. Each property must be studied on its own merits. In some cases the electric range may be utilized in this connection. Electric appliances in the home are particularly pushed by all the commercial departments as a means for improving the load curve. One important item has been the drainage pumping along the Illinois River in southwestern Illinois, where the construction of the Drainage Canal overflowed valuable bottom lands. This load has been an offset to the coal-mining load in southern Illinois because its greatest demand occurs during the slack mining season. Municipal water-supply pumping that can be done during off-peak hours is a type of load that has been particularly developed.

The most important load for this purpose has, however, been the ice plant. The majority of the properties are in territory where natural ice is either limited in supply or not available at all. Forty-eight ice plants have been built up to supply ice in communities in which light and power are supplied. These plants are operated in connection with generating plants, it having been found that the addition of a few laborers to the regular operating forces will permit the operation of both plants at a low labor cost. Ice manufacture can be carried on when power is not needed for other purposes. Because of the high overhead cost a very small ice plant cannot operate as an independent concern supplying ice to the commercial trade. The Middle West Utilities Company is, however, operating plants with a capacity as low as ten tons daily. The largest plant of this kind, operated in connection with the Mounds (Ill.) generating plant, has a capacity of 200 tons per day, and nearly the entire product goes to supply the cars of the Illinois Central Railroad.

A uniform rate structure to cover such a wide spread of properties is impossible. There are, however, certain fundamentals that are being worked out as the rate schedules are remodeled from time to time. These are well illustrated by the rate schedules in Tables I, II, III and IV. The kilowatt-hour rates in these schedules must not be construed as standard for the entire system. The significant fact is the common maximum-demand basis of all but the sign lighting and heating and cooking schedules. The tendency shown by the rate schedules is toward this basis as the fundamentally correct one. Numerous other forms of schedules that are too many to quote are utilized on the various properties.

Electrical System Additions Call for $226,000,000 in 1921

"Electrical World" Survey Shows that Over 1,250,000 Kw. Will Be Added to Generating Plants by Central-Station Companies During 1921

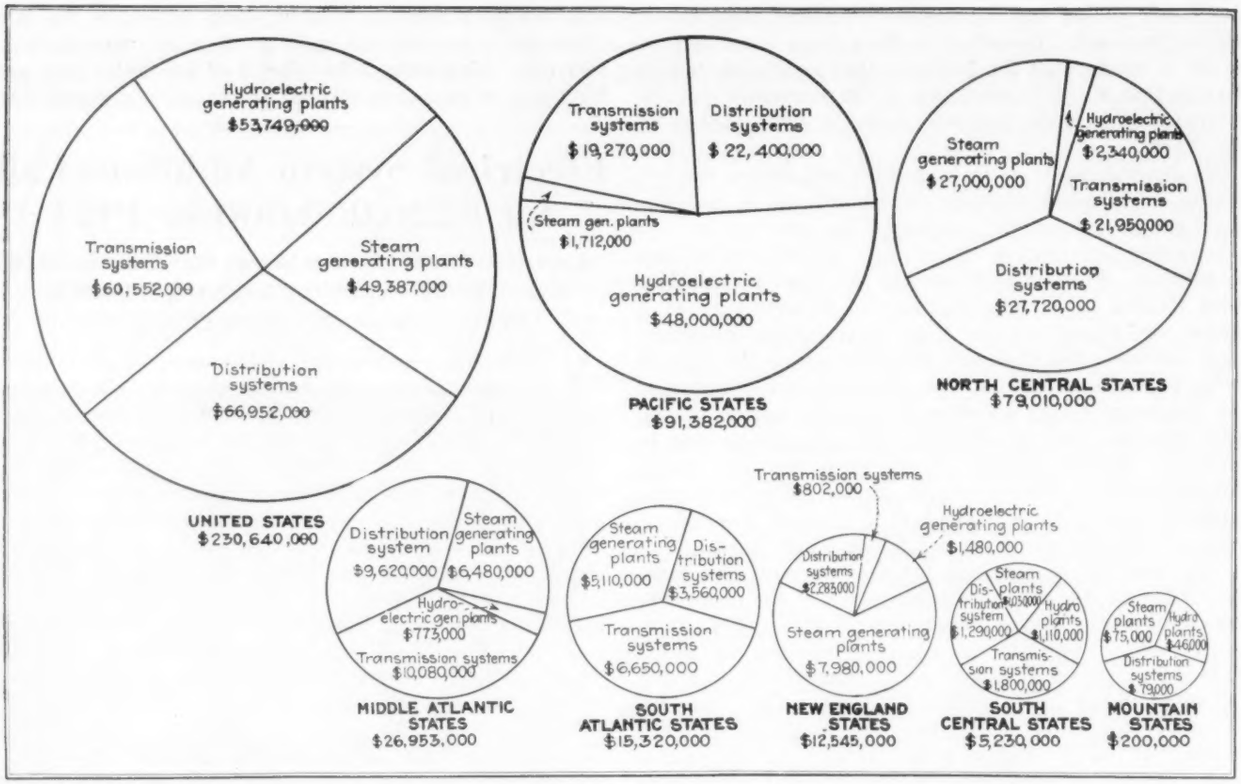
ALTHOUGH construction and equipment costs have materially decreased during the last six months, additions to central generating and distribution systems are going forward as fast as they are financially feasible. It is estimated that at the present time the central electric light and power plants of the United States are deficient about 2,800,000 kw. in installed rating. Owing to the industrial depression and the resulting decrease in industrial energy requirements, the central generating plants of the country are having a brief respite from the constantly accelerating growth which has characterized the industry during the past decade.

Results of a survey of the new-construction plans of the industry just completed by the ELECTRICAL WORLD are given in the table. Based on the returns received from 128 companies, the ELECTRICAL WORLD has made an estimate of the total probable additions to steam and hydro plant equipment, as well as the total value of the probable extensions to the transmission and distribution systems of the country during 1921 by sections of the country.

The total value of the new additions to the central generating, transmission and distribution systems during the present year is estimated at $225,770,000, which figure is about 26 per cent of the gross revenue of all the light and power companies from the sale of energy during 1920. The estimated new generating installation totals 1,251,700 kw., of which about 72 per cent is for steam plants and 28 per cent is for hydro plants. It is not probable that the central generating systems of the country as a whole will be required to carry a load equal to the maximum of 1920 much before next November. If next winter's load does not exceed that of the fall of 1920, and it probably will not, the central generating plants of the country in spite of the new additions now planned will still be deficient about 1,500,000 kw. in installed rating.

TABLE I—SUMMARY OF REPORTS FROM 128 COMPANIES (OVER 2,500 KW. GENERATOR RATING) GIVING ADDITIONS TO GENERATING AND DISTRIBUTING SYSTEMS PURPOSED DURING 1921

Country and Sections	Companies Reporting		Steam-Electric Generating Plants			Hydro-Electric Generating Plants						
	Number	Total Generator Rating Jan. 1, 1921 (Kw.)	Total Generator Rating, Jan. 1, 1921 (Kw.)	Proposed Additions During 1921 (Kw.)	Value of Proposed Additions	Total Rating Jan. 1, 1921 (Kw.)	Proposed Additions During 1921 (Kw.)	Value of Proposed Additions	Total Value of Proposed Additions to Steam and Hydro Generating Plants During 1921	Value of Proposed Additions to Transmission Systems During 1921	Value of Proposed Additions to Distribution Systems During 1921	Total Value of All Proposed Additions During 1921
New England States	18	376,131	258,529	65,000	$2,200,000	117,602	6,375	$500,000	$2,700,000	$250,000	$709,000	$3,659,000
Middle Atlantic States	30	1,542,257	1,163,324	47,000	3,042,450	378,933	45,400	512,500	3,554,950	4,866,500	4,645,732	13,067,182
South Atlantic States	16	371,900	315,950	50,000	2,410,000	55,950	.....	.....	2,410,000	1,715,000	917,000	5,042,000
North Central States	37	515,979	467,529	99,000	6,642,500	48,450	4,175	162,500	6,805,000	2,285,000	2,919,000	12,009,000
South Central States	10	213,300	143,350	4,000	260,000	69,950	13,600	503,000	763,000	410,000	258,000	1,431,000
Mountain States	7	282,660	13,150	1,000	75,000	269,510	2,050	43,000	118,000	.....	35,000	153,000
Pacific States	10	716,556	281,030	37,500	2,712,250	435,525	126,200	23,330,000	26,042,250	6,872,000	10,245,000	43,159,250
United States	128	4,018,783	2,642,862	303,500	$17,342,200	1,375,921	197,800	$25,051,000	$42,393,200	$16,398,500	$19,728,732	$78,520,182



DISTRIBUTION OF ESTIMATED NEW INVESTMENTS BY THE ELECTRIC LIGHT AND POWER INDUSTRY DURING 1921

The greatest expansion during 1921 will take place in the Pacific States and will reach a total value of more than $86,000,000, of which amount 55 per cent will be for hydro-electric plant construction and generating equipment appertaining to it. The North Central States follow with an estimated new investment of almost $80,000,000, of which amount 35 per cent is for steam-electric generating plants. The total value of the additions to transmission and distribution systems is estimated at $121,634,000, an average of $21,300 for each operating company in the United States.

In the Sept. 11, 1920, issue of the ELECTRICAL WORLD was published a tabulation giving the proposed additions of 121 light and power companies during 1920 as totaling $141,867,847. This figure is almost double that reported by the 128 companies making returns for 1921. A study of the returns for both years indicates that with but few exceptions the same companies reported in 1921 as in 1920. If these figures can be taken as a barometer of central-station expansion during these two consecutive years, the conclusion is reached that the total new investments in central-station generating, transmission and distribution equipment during 1921 will total only about one-half those undertaken during 1920. It is undoubtedly true, however, that, due to high cost of material and the financial stringency, a large proportion of the additions contemplated during 1920 were not undertaken. If the 1920 figures are corrected accordingly, it is probable that the proposed additions for 1921 will be about the same as the actual additions made during 1920.

It must be borne in mind that these estimates are for additions to generating and distributing systems which were operating prior to Jan. 1, 1920, and do not include the systems of new operating companies organized during 1920 or 1921.

TABLE II—VALUE OF ADDITIONS TO ALL CENTRAL GENERATING AND DISTRIBUTING SYSTEMS DURING 1921 AS ESTIMATED BY "ELECTRICAL WORLD"

Country and Sections	Steam-Electric Generating Plants			Hydro-Electric Generating Plants			Total Value of Estimated Additions to Steam and Hydro Central Generating Plants During 1921	Value of Estimated Additions to Transmission Systems During 1921	Value of Estimated Additions to Distribution Systems During 1921	Total Value of All Estimated Additions by Central Generating Companies During 1921
	Total Rating of All Steam Central Generating Stations, Jan. 1, 1921, Kw.	Estimated Additions During 1921, Kw.	Value of Additions	Total Rating of All Hydro Central Generating Stations, Jan. 1, 1921, Kw.	Estimated Additions During 1921, Kw.	Value of Proposed Additions				
New England States	862,000	236,000	$7,980,000	345,820	18,700	$1,480,000	$9,460,000	$802,000	$2,283,000	$12,545,000
Middle Atlantic States	2,358,500	102,000	6,480,000	725,500	23,300	773,000	7,253,000	10,080,000	9,620,000	26,953,000
South Atlantic States	818,228	106,000	5,110,000	593,000	.....	.....	5,110,000	6,650,000	3,560,000	15,320,000
North Central States	3,457,367	404,000	27,000,000	799,000	60,000	2,340,000	29,340,000	21,950,000	27,720,000	79,010,000
South Central States	770,198	15,000	1,030,000	185,000	30,000	1,110,000	2,140,000	1,800,000	1,290,000	5,230,000
Mountain States	156,276	1,000	75,000	439,000	2,200	46,000	121,000	.....	79,000	200,000
Pacific States	469,182	37,500	2,712,000	1,029,000	216,000	48,000,000	50,712,000	14,400,000	21,400,000	86,512,000
Totals for United States	8,891,751	901,500	$50,387,000	4,116,320	350,200	$53,749,000	$104,136,000	$55,682,000	$65,952,000	$225,770,000

Utility Management and Policies

INCREASING EMPHASIS is being placed by utility executives on the broader problem of management, such as public relations, finance, organization, and the like, because of the new set of conditions that came in the wake of the war.

Utility Growth to Come Through Public Information

General Recognition of the Economic Relation of Light and Power Companies to Community Welfare Essential to Progress

BY NORMAN READ
Vice-President and General Manager Colorado Power Company, Denver, Col.

ONLY with the support of the public can the utilities grow, earnings be maintained and money commanded at reasonable rates. The public will naturally be back of any enterprise which it honestly feels is essential to its comfort and to its prosperity. It is fair to assume, then, that for electric light and power companies to promote a better public understanding of the economic relation of the company to the community welfare has become essential. In direct ratio with the accomplishment of this object will come public good will.

The early history of Colorado is typical of that of other states. In Colorado the primary sources of the state's wealth came from the gold and silver mines scattered through the Rocky Mountains. Later the development of coal and other mines strengthened the position of the mining industry. Even though the agricultural developments, stimulated in more recent years, have been the source of great wealth, and though there are greater prospects in sight, yet the fact remains in the minds of many of the people of the state that mining is the principal source of wealth and that nothing should be allowed to detract from its development.

Here we have a case where one industry has had consideration over another in spite of the fact that the preferred industry is largely dependent upon the other. Little account seems to be taken of the facts that the introduction of electric power into mining operations has resulted in lower costs of production and that were it not for electricity the mining industry of Colorado would undoubtedly be forced to work to much closer limits. Transportation to most of the mining camps is, at the best, expensive. Had it been necessary to haul coal for the generation of power to operate the mining properties, the added cost might have proved an insurmountable obstacle, especially in the last two or three years. Yet, when the continued existence and expansion of the electric utilities demand more equitable rates for the service rendered, an unenlightened public cries out that the life of the mining industry is threatened.

The public generally is slow to grasp the fundamental nature of the electric light and power service. The case of the mining industry in Colorado and its interrelation with the electrical industry is but one example, yet a typical one. Were the public apprised of the need for protecting and encouraging the electrical industry to the same extent that it lends its sympathies to mining both would make more rapid progress. It would not then be always necessary to expend large sums to present and defend the electric utility's position when questions of rate adjustments are pending. Instead, the public would be inclined to take the part of the electric light and power company and be anxious to be assured that the utility was kept in the most sound and prosperous condition. This is a utopian condition, but one that may be reached if properly approached. It is the manner and the frame of mind in which these ends are reached.

The nation-wide program of good-will advertising that is now being carried out in the popular magazines is one step toward this end. But purely impersonal advertising, even though it be well conceived and has widespread circulation, will not complete the task. To the casual reader glacing over one of these advertisements the thought will come that the intention is right but that it does not come home to him in the closest way. His mind turns to his local utility. He is bound to compare the ideals, so clearly set forth in the advertisement, with the attitude of the electric utility which renders him service. If he has met with good service—if his dealings with his utility have been pleasant and he can feel that his utility has done everything within its power to further the growth of the community, then he will be inclined to heed the case for utilities.

EMPLOYEES THE KEYSTONE

The matter therefore comes back, in the final analysis, to the attitude of the employees of the utilities. They are in a position to influence rightly or wrongly the thought of a large part of the community to which service is given. Increasing attention must be bestowed upon the need for encouraging the employees—both those who officially come in contact with the public and all those others who meet the public through their circle of friends—to pass on correctly the ideals of service held by the utility.

The use of publicity in the presentation of facts in order to build up good will for a utility has a time element of the greatest importance. Publicity during times when the public is not engrossed in the progress of a controversy over rates or service or franchise matters is likely to bear better fruit. The good that will come from publicity at times of controversy is questionable. Then the public is on the defensive. It will be seeking to find flaws in the arguments presented. It will think that the company must be badly in need of protection. Besides, there is the possibility that publicity at such times will only continue the controversy, whereas if less were said, in many cases a settlement would be reached sooner and with less friction.

This is a problem for every utility to work on. It is not alone for the larger companies or the smaller. Each one must do its share. The question is the same in nearly every locality. Build up a broader and a sounder

relation with the public in times of smooth sailing. Do this by constructive work through the medium of the employees, supported by a logical presentation of the facts by means of widespread publicity.

Intensive Sale of Public Utility Securities

Systematic Covering of Territory Enables Company to Do Major Part of Its Financing Through Sale of Preferred Stock—Advertising and Methods Employed

BY PERCY H. WHITING
Manager Securities Department Central Maine Power Company

TO SELL each year $1,500,000 of 7 per cent preferred stock of the Central Maine Power Company, which supplies about 36,000 customers in a widely scattered territory, has presented very serious problems. In view of the facts that this stock is sold at $107.50 per share to net 6½ per cent and that the company does the major part of its financing in this manner an explanation of our methods of intensive selling may be of help to other companies contemplating a customer-ownership plan of financing. Before we start advertising, soliciting or anything else we send a man ahead to get up lists of prospective purchasers. In a town that we serve we run off a list of our customers and have our local representative cross off the hopeless ones. We call on the rest. In a town not on our lines we arrange to have some town official or political expert prepare a list and then have it checked by the tax assessor or tax collector. Frequently we have the list double-checked. We want plenty of "prospects," but we want possibilities only and have found that money spent on getting a good list is money well invested. It is cheaper to hire tax assessors than salesmen. Our instructions to the man who goes after this list is to get the name of everybody who has $100 or more in the bank or who can save $10 a month, and we plan to call on from 10 to 25 per cent of the inhabitants of any town. It takes time, but it is the only way to cover the ground thoroughly.

Behind C. M. P. Preferred is a Big Company with steady earning power
"Investments which pay uninterrupted dividends are generally in companies which perform the widest public service and which rest on the widest human consumption and needs. Such companies have a great public trust and a great industrial responsibility."
BACK of your SHARE
CENTRAL MAINE POWER CO. AUGUSTA, MAINE
POWER and PROFITS
Central Maine Power Company
Augusta, Maine

TYPICAL CUSTOMER-OWNERSHIP PUBLICITY USED BY CENTRAL MAINE POWER COMPANY

The securities department manager, faced with the task of making his field produce every single share that it possibly can, first studies the circulation of the daily and weekly papers in the field he plans to work. Selling must follow advertising. When he starts advertising in any given paper he will plan to cover every town, as well as the intervening countryside, that is dominated by that paper's circulation. Thus he makes his advertising pay the highest possible returns.

When we have our names ready we start our newspaper advertising. Ordinarily we open the campaign with a double-center spread in the daily papers that cover the field. Then we drop to full pages, to halves, to quarters, and then wind up with a long series of advertisements three columns in width and 10 in. deep. While the campaign is on we advertise in nearly every issue of every paper in the field.

The advertisements are adapted as far as is practicable to local conditions. We try to show how the investment in our preferred stock will directly benefit that locality. Another fixed rule in writing our advertisements is to discuss only one point—be it tax exemption, safety or certainty of return. Whatever it may be it is the sole subject of that day's advertisements. I mention this because I have seen so many "bird-shot" security advertisements. We run illustrated advertisements frequently, display them well and insist that they must not be run on the financial page.

Just before we are ready to open our campaign we send a form letter to every prospective customer in the town and try to fit this appeal to the community. The letter always ends by saying that our representative will call. With the letter goes a circular giving the usual facts about the security and the company, but differing from the conventional circular in that the first page contains an illustration designed to picture the possibilities of water power. The whole circular, unlike the usual security circular, is set in type that is easy to read. With these preliminaries out of the way we send all or part of our campaign force into the town. We use about one salesman to every 200 "prospect" cards. The campaign, if at all important, usually starts with an all-day sales meeting, presided over by the sales manager, field manager or his assistant. The special situation in that town is discussed, answers to objections are threshed over and suggestions are made for fitting the sales talks to local conditions.

Then the campaign begins. Not only are all the "prospects" in the town carefully followed up, but also every road leading from that town out into the coun-

try. The rural work is done almost on a house-to-house basis. Each salesman reports on each call by filling out a card. These reports are filed and they give us a wonderful "prospect" list. In the past two and a half years our salesmen have called on probably 50,000 people and have reported on most of them.

The wise securities manager will have even the smallest towns worked. Our motto is "Every town with people in it is our town." The most productive of all are prosperous small towns which have no bank. One of our salesmen once spent two days in a town that numbered two families and sold his week's quota there. It is by no means enough, however, to work the small towns alone—the salesman must go out into the rural districts and work them, road by road. He will, if his experience is like ours, meet his best success there.

Naturally even the best sort of "campaign" is a sketchy affair. It lands only such customers as are ripe and ready, leaving many of the best for a later period. When enough towns have been worked to make a total population of from 25,000 to 35,000 we have a new "territory" ready. This territory is declared closed and put in charge of a resident salesman. Usually it is awarded to the leading man on the campaign force. He settles down there and begins to work his towns on a continuous, year-round basis. A man so situated in a territory can usually produce considerably more business than when he was campaigning.

Size of Territories

The population of our territories averages 26,000 people. On this basis, when we complete our canvass of Maine, which we hope to do within six months, we shall have the entire state handled by twenty-eight "territory" salesmen. Our present tendency is to cut down, rather than to enlarge, territories. In normal times it seems likely that one salesman could make his best showing working in a territory of perhaps 20,000 people. We are experimenting now on some territories that contain, on an average, 11,000 people. The average bond salesman in a town of 11,000 people would probably not have more than from five to ten "prospects"—and not over a day's work every month.

Recently, while on the way to start soliciting in a new town, I was talking with a bond salesman. "How many people do you bond salesmen call on in this town?" I asked him. "Three," he replied. We worked that same town three weeks with three salesmen and found it productive.

To central-station companies which are finding that they have to sell more securities we recommend heartily that they discontinue the practice of "spotting around" and get down to "covering." Until that is done the central-station company cannot hope to come anywhere near the possibilities of the field. The bond men say that such a course is suicidal, that it will soon reach the saturation point. Our experience, based on fairly intensive selling spread over nearly three years, is that the saturation point will be reached about the same time that the savings banks put up their shutters and quit—and that's a long way off. The amount of stock we have sold since our intensive campaign began, in the summer of 1918, is close to $3,000,000, par value.

From the customer-ownership advertising comes a surprising amount of help in enlisting support in public-relation matters. The very nature of the effort to sell preferred stock is an appeal to recognize what the company is doing to build up its community. The idea of sharing the ownership and the earnings of the power company with the people is steadily hammered home.

When the Legislature of Maine took up the question of state ownership of water powers our company took stock of the situation and found that through two and a half years of customer-ownership advertising it had presented its case to the people of Maine. It had told its "public relations" story, not through "propaganda" advertisements, but in connection with an appeal that the people of Maine unite with it in building up the state. In any political crisis this advertising will be worth all it has cost as good-will advertising—yet it paid for itself as it went along in helping to sell preferred stock.

Electrical Merchandising by the Central-Station Company

Merchandising Department Should Earn Fair Profit—Central Station Company Best Medium for Introducing New Devices—Results Attained

TO WHAT extent the central-station company should engage in merchandising and the best methods to adopt to make this business return a fair profit have for long been topics which offer a fertile field for differences of opinion. That the sale of electrical merchandise can be made to return a fair profit to the electric light and power company when conducted properly has been demonstrated by a number of companies. However, there is a belief on the part of some in the electrical industry, including certain central-station executives, that the electric light and power company is in business only to sell electrical energy and that the sale of electrical devices is out of its field. Others have gone so far in the opposite direction as to maintain that the electric utility not only should sell all kinds of energy-consuming devices but should sell them at cost in order to increase the kilowatt-hour sales. The latter policy has brought a storm of protest from dealers, many of whom think that central-station men are trying to drive them out of business.

Companies which operate in scattered territories serving small towns and rural communities are frequently the only means through which their customers can procure electrical devices. Through small local offices and occasional visits of salesmen the central-station company is able to sell appliances where dealers would find it difficult to maintain a shop or send canvassers. Without this service by the electric light and power company such customers would for the most part go without electrical devices.

Central-Station Company Must "Pioneer" New Devices

In the earlier days, when the first appliances were brought out and were passing through a strenuous period of development, it was natural that the central-station company proved the only medium through which these devices could be introduced. Now these companies feel that, having borne this expense of introduction and development, it is not logical to expect them to step out of the business as soon as a market has been created.

Taking it for granted that a central-station company conducts a merchandising department, there is the problem of making it pay a profit. That it must be conducted on business principles is obvious. Prominently located salesrooms and offices, well stocked with goods

properly displayed, backed up with a force of salesmen who will make frequent calls on all consumers, produce results. Advertising is essential, but it has to be done intelligently and it is money wasted unless it carries a selling appeal as strong as does the advertising of other merchants in the same town.

In the past some companies have been confused as to just what charges to make against the merchandising department. The N. E. L. A. classification of accounts provides a system of accounting for this department which if followed will show exactly the results obtained. In general it should be remembered that that branch of the commercial department engaged in selling energy to power and industrial consumers should be charged with its proper proportion of overhead expense and that the merchandising department should be charged likewise in order to determine whether the latter is paying its way.

PROFITS FROM MERCHANDISING

The volume of business that can be done by a central-station company will naturally depend proportionately upon the aggressiveness of its sales policy. The possibilities of merchandising can best be judged from the results obtained by companies which have successfully conducted such a department. In a recent paper D. W. Snyder, general manager of the Bloomington & Normal (Ill.) Railway & Light Company, stated that in a territory including a town of 28,000 people and about a dozen small communities daily sales amounted to $500 per day—approximately $150,000 for the year. Net revenue was $36,244.50, from which should be deducted $9,153.85 for advertising and development expense, leaving a net profit of $27,090.65. The average merchandise stock carried was $28,000. These figures are significant, as it will be noted that this stock was turned over five and a quarter times during the year and that the net profit was very nearly as great as the average investment in stock. Compare this with the revenue from kilowatt-hour sales where the capital is turned over once in five years. The rate of turnover on merchandising in this case was twenty-six and a quarter times as fast as that on kilowatt-hour sales.

A holding company which operates about twelve properties throughout the country had up to 1917 conducted its commercial department with a view to increasing consumption of energy. It then changed its policy, started selling appliances at list prices and planned to make the department self-supporting. A comparison of the company's gross revenue, expense and net earnings from merchandising during the past five years follows:

	1920	1919	1918	1917	1916
Gross revenue	$760,117	$597,653	$471,660	$85,744	$429,265
Expenses	598,860	491,389	424,648	84,495	457,294
Net earnings	$161,257	$106,264	$47,012	*$1,249	*$28,029
Promotion expenses:					
Total promotion expense charged to gas, electric and steam operations. .	$83,288	$74,443	$61,169	$83,695	$11,214
Excess or deficiency of merchandise and jobbing earnings over company's total promotion expense	$77,969	$31,821	*$14,157	*$82,446	*$146,243

* Deficit.

The items under "promotion expenses" were charged to operations and were not a direct charge against the merchandising business. From these figures it will be seen that this company has been able to pay all of its promotion expenses from the sale of merchandise and that for the years 1919 and 1920 a net profit was made over and above all these charges.

The Colorado Springs Light, Heat & Power Company, which serves a population of about 35,000, reports these figures for 1920:

Gross income from merchandising	$68,925.87
Expenses	62,807.53
Net profit	$6,117.84

This company had a stock turnover of four and a half times during the year, the stock investment never exceeding $15,000. This investment, however, was considered by the company to be unusually large, since, because of its inability to obtain material as needed, it was necessary to increase the usual stock nearly 100 per cent. Under normal conditions the stock investment was about $8,000.

As to the growth of merchandise sales, a Western company in 1913 had a gross merchandising revenue of not quite $100,000. In 1920, seven years later, this company's gross revenue from this source was a little over $900,000. Still another company asserted that the profits from its merchandise sales were sufficient to pay one-half the dividends on its outstanding preferred stock. In one company the average gross sales per month to residential customers equaled the amount accruing from kilowatt-hour sales to these customers.

RATE OF CAPITAL TURNOVER

When considering the possibilities of a merchandising department, one outstanding feature is the small investment required per dollar of gross income as compared with the investment in plant and equipment necessary for the sale of kilowatt-hours. Furthermore, the investment in a merchandise stock can be increased or decreased pretty much at the will of the manager, but to decrease the capital invested in a utility property is next to impossible. The earnings from the sale of electrical merchandise are not subject to commission regulation, and the central-station company is at liberty to expand or retrench on its activities as varying conditions may dictate.

One question which will probably always be kept open for discussion is the relation between the electric light and power company and the contractor-dealers. What differences have existed are for the most part the result of misunderstanding. As a matter of fact, where the central-station company has conducted its merchandising business along aggressive lines, following the principles of any other merchant, it has been demonstrated that the business of the contractor-dealer has been benefited and actually increased. On the other hand, in some instances where the central-station company has retired from this field the use of electric appliances has shown a decided falling off. Experience proves that there is plenty of room in the field for both the central station and responsible dealers and that the result of honest competition will bring increased business to both.

The central-station company is directly interested in securing the largest and widest distribution of electrical devices to its customers, and it cannot well afford to abandon this field. With this end in mind, the electric light and power company's merchandising policy may be summed up as follows:

To operate this department upon a profitable basis, observing business ethics; to sell only standard appli-

ances which will require the least amount of service and repair work, but to do such work promptly when necessary; not to do house wiring where there are responsible and reliable contractors to handle this class of work; to co-operate with local contractor-dealers; to conduct the merchandising department with a view to increasing the use of electrical energy and developing the use of new devices and appliances, thereby rendering to its customers the best service possible.

Organizing for Efficient Operation

How a Company Serving a Territory of 300 Square Miles and Containing 3,100 Electric Consumers Is Equipped to Give Good Service Economically

BY WALTER P. SCHWABE
Vice-President and General Manager Northern Connecticut Light & Power Company, Thompsonville, Conn.

THE organization of small electric service companies covering a considerable territory and serving a moderate-sized population demands careful planning in order to insure efficient operation. To achieve success constructive planning of plant improvements and business development is essential. Mistakes that cost money affect the future of a small company much more than they affect a large one where the financial loss might even be hardly noticed. Therefore an excellent opportunity exists for thorough systematization of all phases of company work, for clear definition of responsibilities and for the establishment of vigorous and positive policies.

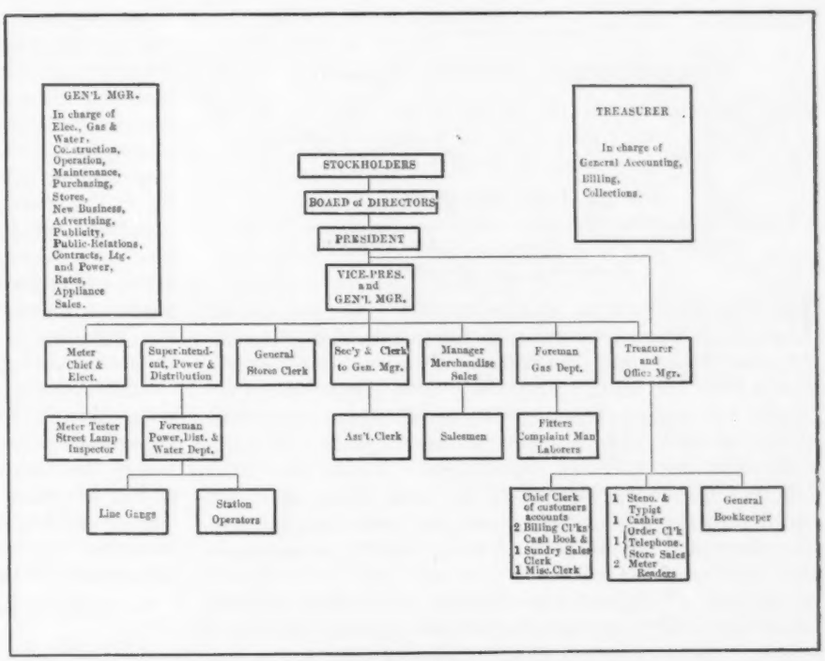
Since large companies can make many refinements in organization and methods of handling work that smaller companies cannot afford, the writer will refer to a moderate-size utility serving a population of 28,000 people scattered over 300 square miles to illustrate what small companies may profitably do. The company to which the writer refers furnishes three services—water, gas and electricity—supplying 2,400 water consumers, 2,700 gas consumers and 3,100 consumers of electricity respectively. Good public relations are maintained principally by the personal contact of employees in public affairs, the general manager being a director in two building and loan associations and president of one, a director in the Connecticut Chamber of Commerce from the local Board of Trade and concerned in many other activities.

The accounting department is in charge of the treasurer, with one bookkeeper, cashier, chief clerk and five assistants. The accounting, meter reading, billing and commercial work of the water companies are also handled by this force, and for this a fixed charge is made to these companies. Meters are read continually for twenty days by two men, bills being mailed daily. Electric, gas and water meters are read at the same time. An Elliott-Fisher billing machine is used and addressograph work is done by meter readers when not in the field. Four collection agencies are maintained, at which points customers' complaints are also received. These agencies deposit receipts daily in a local bank to the credit of the company, mailing duplicate deposit slips with coupons from bills and any complaints received to the cashier at Thompsonville. All complaint notices are turned over to the order clerk, who takes all telephone calls from the entire territory. Virtually all customers can call the company's office without toll charges.

Line construction and maintenance is handled by one gang, consisting of a foreman, three linemen and a ground man with a White truck. A Stewart truck with two men is used in making service connections and small repairs, all under the direction of the superintendent of power and distribution.

The company does no wiring or repairs to wiring. Eight or ten small contractors in the territory do this work, and the company co-operates with them fully, especially in financing time-payment jobs.

Meter maintenance and setting, appliance repairs and utilization complaints are handled by the meter chief and two assistants. Street-lamp inspection and replacements are cared for by one inspector and an automobile.


GEN'L MGR.
In charge of Elec., Gas & Water, Construction, Operation, Maintenance, Purchasing, Stores, New Business, Advertising, Publicity, Public Relations, Contracts, Ltg. and Power, Rates, Appliance Sales.
STOCKHOLDERS
BOARD of DIRECTORS
PRESIDENT
TREASURER
In charge of General Accounting, Billing, Collections.
VICE-PRES. and GEN'L MGR.
Meter Chief & Elect.
Superintendent, Power & Distribution
General Stores Clerk
Sec'y & Clerk to Gen. Mgr.
Manager Merchandise Sales
Foreman Gas Dept.
Treasurer and Office Mgr.
Meter Tester Street Lamp Inspector
Foreman Power, Dist. & Water Dept.
Ass't. Clerk
Salesmen
Fitters Complaint Man Laborers
Line Gangs
Station Operators
Chief Clerk of customers accounts
2 Billing Cl'ks
Cash Book & Sundry Sales Clerk
1 Misc. Clerk
1 Steno. & Typist
1 Cashier
1 Order Cl'k Telephone. Store Sales
2 Meter Readers
General Bookkeeper

ORGANIZATION OF PERSONNEL IN A MEDIUM-SIZE COMPANY

The company operates about 1,100 street lamps, illuminating 60 miles (96 km.) of highway. This department also keeps history card records of all poles, meters, transformers and street lamps and maintains up-to-date distribution system maps. Line extensions applied for are investigated by the superintendent of distribution, who estimates the cost and sketches the required detail on a special form. When the cost of an extension exceeds the outlay warranted by the estimated revenue, the applicants pay 14 per cent fixed charge on the excess line cost in addition to the regular charges for service.

A showroom is maintained at the Thompsonville office, in charge of the merchandising manager. Sales are made principally through an outside salesman, with an automobile, working on a commission. Merchandising is aggressively promoted, and the merchandising manager's salary depends on the net profits from this department, which is charged with fixed overhead expenses, such as rent, merchandising and advertising expense,

sales commissions, interest on inventory, storeroom expense and clerk hire. Last year merchandise sales totaled $26,000. Four cooking lectures have been given during the past month to promote the use of the electric range, and the annual house-wiring campaign is on during the month of May. Three months' free service and one year to pay for wiring are offered as inducements.

Advertising material for the promotion of better public relations prepared by the National Electric Light Association and the American Gas Association is largely used in the local press. Twelve periodicals of public utility interest are taken by the company. Nineteen of the twenty-one employees in the company's electrical department are members of the N. E. L. A., the company paying the dues.

Until a few years ago improvements and extensions were financed by sale of bonds and preferred stock through Boston and Hartford bankers, but during the past year money was temporarily obtained through a bank loan. The company is now considering financing by a sale of some form of security to its customers and employees.

Transforming Public Opinion

Two Difficulties that Often Block the Way to Better Relations with Customers—A Western Company's "Department of Greater Service"

BY S. M. KENNEDY
Vice-President in Charge of Business Development and Public Relations Southern California Edison Company, Los Angeles

PERHAPS there is at the present time no subject which is more constantly in the minds of public utility executives and managers of commercial enterprises than the topic of relations with the public. Certainly no subject is more discussed when representatives of such organizations gather together in committees or assemble at conventions. Those who have followed the course of events for some years past can recall that for a long time there was seemingly a careless disregard on the part of many utility managers of the opinion of the public concerning their business and operations. Today all has changed, and a keen anxiety regarding public opinion is observed in many directions where it has not been noticeable heretofore.

Notwithstanding all that has been said and written during the past few years on the subject of the relations between public utility companies and their consumers, there undoubtedly lurks in the minds of a considerable portion of the public a rooted dislike of them. To many an otherwise clear-headed man the ways of big corporations are a dark and impenetrable mystery. He is inclined to look with suspicion on all they do. The millions tossed about so freely in annual reports frequently seem to him ill-gotten gains that he would like to see distributed among the so-called common people.

TWO DIFFICULTIES IN THE WAY

There are two difficulties yet remaining before the pathway to better public opinion can be cleared of the obstructions that block or impede progress. The first is that the majority of those composing the public are liable to consider utility companies collectively rather than individually. Consequently those corporations that do not progress not only stand in their own light but they help keep the light of truth from spreading. They also blind the public vision to the good intentions of other companies whose methods may be more conciliatory and progressive. The second difficulty is caused by such utility companies as announce they are going to do thus and so, with the idea of conveying to the minds of their patrons that radical changes are to be inaugurated and strenuous efforts made to please, and who do not live up to their promises. Then there are other companies with really good intentions whose officers think they have adopted progressive methods but whose employees are either ignoring instructions or have not been told what to do. Their patrons and the public in general are not getting what was promised and the people cannot be blamed if in their disappointment they say things uncomplimentary to the corporations that have not kept faith with them.

It is generally conceded that the day has long since passed when the management of any industrial or utility organization can ignore public opinion. It is asserted, however, that there are corporations whose managing officers may have the right ideas regarding intercourse with the public but who do not make it their business to see that these ideas are promulgated among their assistants and the employees down the line. They do not "follow through," and consequently excellent thoughts and good intentions are dissipated and lost because they fail to reach the points of contact where they would produce desired results. There never was a time before when people at large gave to public utility companies such close attention. These corporations occupy greater prominence than ever before, not only because of the increasing demands for the service supplied, but also because many utility companies are looking to their consumers for copartners in the industry in which they are the ultimate patrons. It is an axiom that money flows only to where there is confidence, and confidence is acquired by many only after the closest scrutiny. The unreasoning and unreasonable consumer is fast disappearing in territories where the standard of public relations has been raised, and in his place there has arisen the thinking individual who is willing to meet the progressive company's outstretched hand more than half way, and whose friendship and good will become tangible assets.

EMPLOYEES' ATTITUDE OF VITAL IMPORTANCE

After all, it will usually be found that down the line most utility companies have the kind of employees who can carry out instructions given and follow examples set. It is for the management to decide what shall be the instructions and whose example shall be followed. Employees are as much a part of the organization as the president. The elevator operator meets more people than the general manager. Does he do it in the right way? The troubleman has more personal contact with the public than the chief engineer. Does he make a good impression? The collector greets more consumers than the treasurer. Does he perform the difficult task of taking people's money and leaving them pleased? The knack of saying and doing the right thing at the right time is a wonderful asset in public relations, and its absence has been the cause of many a company's loss and many a man's failure. Strangely enough, it not infrequently happens that some men who have failed have given considerable thought to the subject of meeting and dealing with the people in a pleasing way. They missed the mark because they did not get the real philosophy of it. They have tried to please

the people, but have overlooked the individual. Successful business is business plus personality. The more a business is crowded with personality the faster it will grow and prosper. Orders issued from leather-lined swivel chairs regarding public relations will not do the work; instructions given across mahogany tables regarding treatment of consumers will fall short; resolutions of boards of directors containing stock phrases regarding courtesy and consideration to the public will be entirely ineffective if the crux of the subject is overlooked. Employees are individuals and consumers are individuals, and as individuals the one class representing the company meets the other class representing the public and it is in the contact that good will is made or ill will engendered.

The management of a company may announce a policy regarding its attitude on public relations, and it will be assumed that this policy will be made known to all employees, and by various means eventually to all consumers and the public in general. But one announcement to either employees or the public will not accomplish the desired result. Those who have given the matter of publicity and spreading information a study, such as publishers, writers and big advertisers, know that the people do not learn the facts on any subject or catch the ideas it may be desired to convey by one announcement. They know it requires constant iteration and reiteration and continuous hammering to drive home to the people the idea it may be desired to implant.

The methods adopted to improve public relations require to be both instructive and constructive. Employees should not only be told what to do but also how to do it. The public should be informed not only concerning the company's aims and ideals but how it proposes to put them into effect. Above all, the question of improving public relations and acquiring public good will is essentially progressive. There can be no measure of success in starting from the top and working downward. It is better far to start at the bottom—make the foundation firm and then build upward. Further, it is as necessary to give proper publicity to a company's desires and plans for improved public relations as it is to advertise in order to sell merchandise. The people can't be expected to know unless they are told.

UTILITY OF PICTURE DISPLAYS

The nerves from the eyes to the brain are many times larger than those from the ear to the brain. Therefore, when possible, the use of pictures is recommended. A central-station company, for instance, should display pictures of power plants, waterfalls, interiors of offices, uses of electricity, etc., and use a few words as connecting links for the pictures. As an illustration of the value of this medium for publicity one has only to look at how the film industry has developed during the past ten years.

A Western company that has given to public relations a close study for many years has made another step forward by inaugurating a "department of greater service." The officers of most public utility companies assume that the service supplied is satisfactory if no complaints are made. This may appear, under ordinary conditions, a fair assumption. But the company referred to is not satisfied with what may be termed a negative answer as to conditions of service—it wants from its consumers a positive statement. The new department consists of a staff of approximately twenty-five men, carefully selected for the special work to which they are assigned. These men have been patiently schooled as to the company's history, organization, departments, operations, developments, aims, ideas and practices, and have been distributed over the company's system, one man to each geographical district. Each man reports through the local district manager to the head of the department of greater service in the general offices. The work of the men in the department of greater service in each district will be fourfold, as follows:

To inquire from each consumer whether or not the service supplied by the company is satisfactory in every respect. This refers not only to the physical service, but also to the consumer's relations with meter readers, collectors, troublemen, clerks, telephone operators and other employees of the company with whom he may come in contact.

To give consumers, where the information is needed or desired, details regarding rate schedules and methods of charging for service, the welfare work assumed by the company in behalf of its employees and the present and prospective development work which is being carried on for the benefit of the communities served, the idea being to create an interest in the company's affairs and to convey the thought that the work the company is doing is for the benefit of the territory supplied and that the more rapidly the company's business grows and develops, the more rapidly will the state progress in its onward march.

To ascertain the mental attitude of each consumer interviewed, the idea being to find out if the consumer is (a) in accord with the company's operations and prospective development work, (b) indifferent to what the company is doing, or (c) in any way antagonistic to the company.

Assuming that the conditions are satisfactory, the representative of the department of greater service will explain to the consumer the company's plan for customer ownership and its desire that all consumers, if it be possible, shall become personally interested in the company's operations, even if only to a minimum amount.

The company which has put into effect this new idea of sending trained men into the field to "look for trouble" is more than satisfied with the results being obtained. Where any troubles are reported they are immediately remedied. Where information is asked it is freely given. The officers of the company are learning more about the business than they knew before. Employees are becoming more alert to see that the service is what the management desires—high-grade in every respect. Finally, consumers are greatly pleased with the attention and courtesy displayed by the company, and public good will is being developed and strengthened to a remarkable degree.

In military affairs a commanding officer plans to capture and hold a position. Public good will should be captured and held in the same manner. It is no hit-or-miss affair. The great lesson to be learned by company executives and managers is that this much-desired good will cannot be obtained by treating with consumers as classes or communities, but rather by giving recognition to the individuality of each whose friendship is sought. For the public is made up of individuals, and it is the man in the street and the woman in the home who mold public opinion.

Station Economies and Production Costs

NEVER HAS THE TIME been more opportune for emphasis upon systematic maintenance of utility properties and careful checking of station operating economy than at present. Actual operating results reflecting present conditions should be set up for progressive engineers to aim at.

Operating Costs of Small, Medium and Superpower Plants

Costs and Performance of Steam Generating Plants in Superpower Region—Effect of Size of Plant, Size of Units and Plant Factor

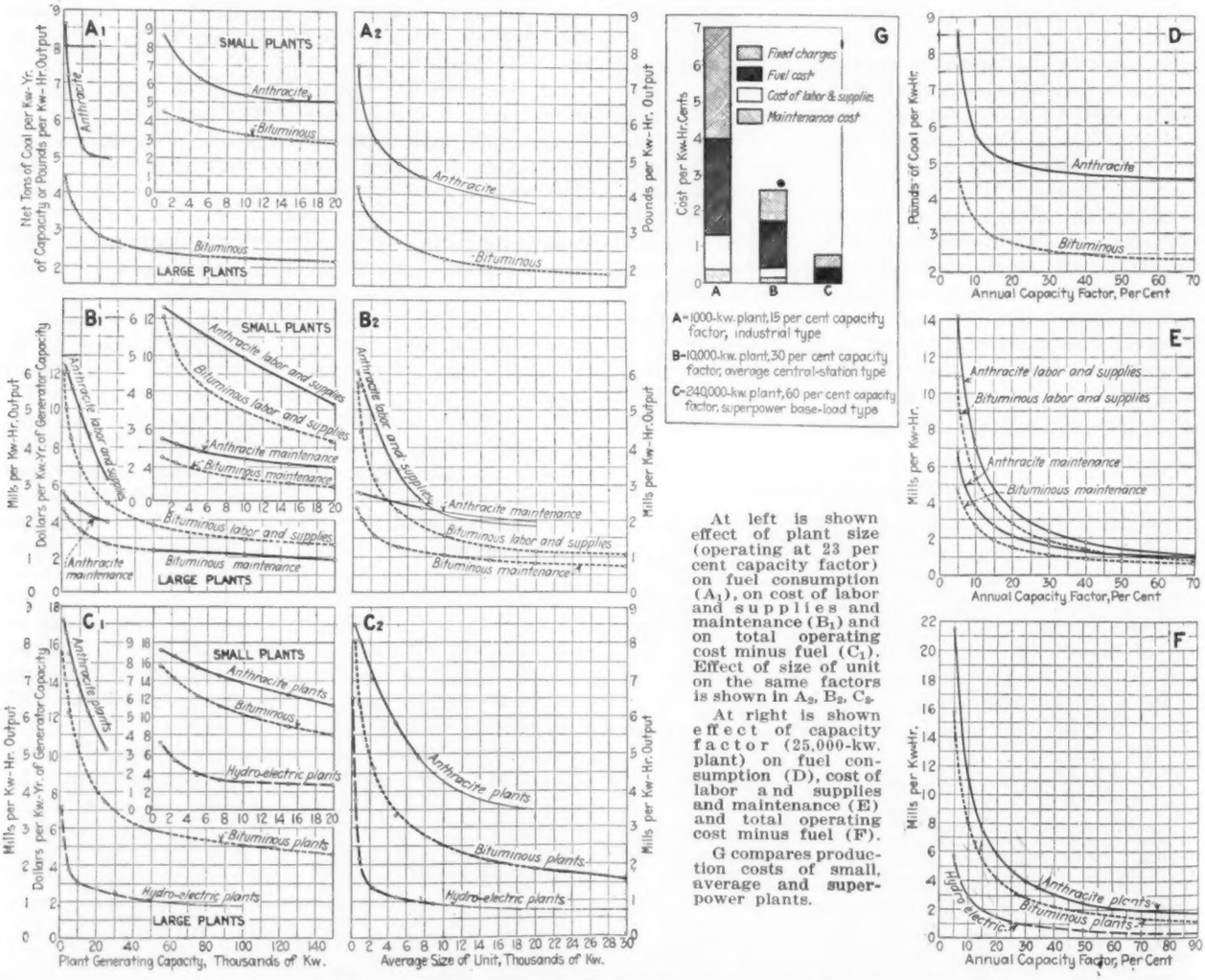
BY HENRY FLOOD, JR.*

A COMPARISON of operating costs of small, medium-sized and large superpower steam generating plants has been made possible by the Superpower Survey conducted by the United States Geological Survey. In this survey records of 219 plants in the Superpower Zone were analyzed in order to ascertain their performance and operating cost with relation to size of plants and with relation to the capacity factor† at which the plants operated. The summaries of the analyses which are given in the accompanying table bring out strikingly the effects of these two conditions on the cost of generating power.

The Superpower Zone, which extends along the Atlantic seacoast from Washington to Portsmouth, N. H., and inland on an average about 150 miles, contains some 400 steam-electric plants in the electric utility

*Mr. Flood is engineer-secretary of the Superpower Survey being conducted by the United States Geological Survey, of which George Otis Smith is director. W. S. Murray is chairman of the Superpower Survey.

†"Capacity factor" as used throughout this discussion is equivalent to the term "plant factor" as defined in the A. I. E. E. Standardization Rules. It is the ratio of the average load to the aggregate rating of the plant.—EDITOR.



At left is shown effect of plant size (operating at 23 per cent capacity factor) on fuel consumption (A_1), on cost of labor and supplies and maintenance (B_1) and on total operating cost minus fuel (C_1). Effect of size of unit on the same factors is shown in A_2, B_2, C_2.

At right is shown effect of capacity factor (25,000-kw. plant) on fuel consumption (D), cost of labor and supplies and maintenance (E) and total operating cost minus fuel (F).

G compares production costs of small, average and superpower plants.

COAL CONSUMPTION AND OPERATING COSTS FOR PLANTS OF DIFFERENT SIZE

OPERATING STATISTICS AND COSTS FOR STEAM-ELECTRIC PLANTS IN SUPERPOWER REGION—YEAR 1919

	BITUMINOUS COAL										ANTHRACITE COAL									
	Under 1,000 Kw.	1,000 to 2,500 Kw.	2,500 to 5,000 Kw.	5,000 to 10,000 Kw.	10,000 to 25,000 Kw.	25,000 to 50,000 Kw.	50,000 to 100,000 Kw.	Over 100,000 Kw.	All Plants	Three Best Plants	Ten Best Plants	Under 1,000 Kw.	1,000 to 2,500 Kw.	2,500 to 5,000 Kw.	5,000 to 10,000 Kw.	10,000 to 25,000 Kw.	25,000 to 50,000 Kw.	All Plants
Number of plants	33	36	32	29	31	14	13	8	196	3	10	3	6	5	4	2	3	23
Average yearly output (th usands of kw.-hr.)	1,016	2,827	6,680	12,110	30,610	62,600	172,500	335,037	38,020	248,635	193,050	697	2,036	7,280	15,551	43,925	125,275	25,050
Average peak load, kw	545	1,508	2,790	5,600	12,210	21,880	50,600	102,750	12,680	72,200	62,499	322	901	2,068	5,715	14,000	27,783	6,570
Total generator reserve, per cent	30.8	32.0	36.1	42.0	34.2	53.8	37.7	60.5	46.5	35.0	48.6	73.5	53.5	59.6	9.8	22.2	6.15	15.5
Total effective reserve, per cent	19.8	13.2	19.0	25.0	18.8	27.1	9.7	27.5	20.6	9.4	12.5	73.5	40.5	47.5	—9.0	15.0	—1.2	5.9
Average generator capacity, kw	705	1,720	3,790	7,950	16,400	34,100	69,300	164,500	18,400	97,500	92,760	560	1,380	3,300	6,270	17,100	29,500	7,590
Average effective capacity, kw	650	1,510	3,320	7,000	14,500	28,000	55,500	131,000	15,300	79,000	80,255	560	1,270	3,070	5,200	16,100	27,430	6,950
Ratio of total to effective capacity	1.09	1.14	1.15	1.14	1.13	1.21	1.25	1.26	1.18	1.23	1.15	1.0	1.09	1.08	1.21	1.06	1.08	1.09
Average size of unit, kw	273	540	905	1,580	3,000	6,420	12,600	15,800	4,140	28,200	15,400	240	460	970	1,255	3,420	7,375	2,080
Load factor, per cent	21.3	24.7	27.3	24.7	28.6	32.6	38.4	37.2	34.4	39.3	35.2	24.7	25.8	40.2	31.0	35.8	51.5	43.5
Capacity factor:																		
(a) On total generator capacity, per cent	16.4	18.6	20.2	18.2	21.3	21.0	28.2	23.5	23.3	29.0	23.8	14.2	16.8	25.0	28.3	29.4	48.5	37.6
(b) On effective capacity, per cent	17.7	21.4	23.0	19.7	24.2	25.4	35.5	29.4	28.4	36.0	27.4	14.2	18.3	27.2	34.0	31.0	52.0	41.0
Net tons fuel per kw.-yr. of generator capacity	4.34	3.45	3.18	2.90	2.85	2.30	2.72	2.20	2.55	2.23	1.94	8.85	5.7	8.7	6.4	6.4	9.27	8.05
Maintenance cost per kw.-yr. of generator capacity	$7.82	$3.95	$3.72	$3.65	$2.90	$2.07	$2.45	$1.80	$2.42	$1.07	$1.64	$4.95	$4.71	$3.25	$5.46	$5.29	$4.89	$4.87
Labor and supplies per kw.-yr. of generator capacity	$13.38	$11.90	$9.00	$7.10	$6.10	$3.57	$3.76	$2.54	$5.18	$2.10	$2.13	$15.00	$10.80	$10.20	$10.80	$8.26	$5.18	$7.44
Fuel cost per kw.-yr. of generator capacity*	$23.50	$18.60	$17.20	$15.65	$15.40	$12.40	$14.70	$11.90	$13.80	$12.05	$10.50	$23.75	$15.28	$23.35	$17.15	$17.15	$24.85	$21.57
Fuel cost to total operating cost, per cent	52.5	54.0	57.5	59.5	63.0	67.0	70.0	73.0	64.5	79	74	54.3	49.6	63.5	51.3	55.9	71.2	63.7

* Bituminous coal, $5.40 per net ton in bunkers. Anthracite coal, $3 per gross ton in bunkers.

industry. While it is recognized that the cost of producing power varies over wide limits with local conditions, such as the cost of coal, the availability and temperature of condensing water and other factors, it is nevertheless true that where so many data are available it is possible to determine the average performance and the average operating cost of power when the data are properly analyzed. These 400 steam-electric plants generated very nearly 9,000,000,000 kw.-hr. in 1919. Of these plants, 219, totaling some 3,820,000 kw. of installed capacity, were found to have very excellent records both as to performance and as to operating cost. These plants had a total output of approximately 8,000,000,000 kw.-hr., or very nearly 90 per cent of the total amount of energy generated in the superpower region by steam-electric plants. For the purpose of showing the variation of performance and cost with the size of plants, Charts A_1, A_2, B_1, B_2, C_1 and C_2 have been prepared. Chart A_1, showing the variation of fuel consumption at the constant capacity factor of 23 per cent, brings out that fuel consumption decreases rapidly as the plant becomes larger for plants of less than 50,000 kw., while it decreases at a comparatively slower rate for plants of more than 50,000-kw. capacity.

In chart A_2 is shown the same variation in fuel performance with the size of the generating unit. Here is brought out the decreased cost of generation for the larger units. These curves were developed for the reason that many of our large stations today are equipped with a large number of small units as compared with the present tendency toward a small number of large units.

Charts B_1 and B_2 show the variation of maintenance cost and of labor and supplies with the size of the plant at a constant capacity factor, while Charts C_1 and C_2 show the total of all operating cost, except fuel, with its relation to size of plant. On this particular curve sheet there has also been shown the total operating cost of hydro-electric plants. These costs were developed from a study of fifty-eight selected hydro-electric plants within the region, and it strikingly brings out the lower cost for the operation of hydro-electric plants regardless of size.

To show the variation of the cost of power with changing capacity factors Charts D, E and F are presented. In order to keep these charts simple, only one size of plant is shown—*i.e.*, 25,000 kw.—and the coal consumption of these plants is plotted for various annual capacity factors on Chart D, while the costs of maintenance and of labor and supplies are plotted on Chart E, and the total of all production costs excepting that for fuel is indicated on Chart F.

All of these costs are given for both bituminous and anthracite coal. The bitumious coal in all cases shows substantially lower costs.

As the result of this investigation a very interesting comparison has been made on Chart G. This shows the cost of operating small isolated plants, average central-station plants and superpower plants. In the Superpower Zone the average size of isolated plants in the manufacturing industry will be considerably less than 1,000 kw., and they will operate at a capacity factor of approximately 15 per cent. The average size of central station in the zone is 10,000 kw., operating at an annual capacity factor of approximately 30 per cent. The superpower plant is rated at about 100,000 kw. and will operate at about 60 per cent capacity factor. For the purpose of carrying the base of the load the superpower system should have very large stations which will operate at high capacity factors in order to produce the bulk of the energy at a very low production cost.

It is interesting to note that the total cost of energy for the average industrial type of plant is about 7 cents per kilowatt-hour, compared with about 0.8 cent per kilowatt-hour for the superpower base-load type. It is also interesting to note that the total production cost of power in the base-load type of station is actually less than the operating charges alone for the average central-station type.

The conclusion to be drawn from a study of these tables and charts is that the time is now at hand to stop building small-sized power plants at local centers, which are limited to small-capacity installations and to operation at very low capacity factors. Instead the larger, highly economical stations should be interconnected to serve intermediate territory.

Instruments Indispensable for Boiler Room Economy

Economical Operation Is Virtually Impossible Without Measurements of Coal, Water, Etc.—Instruments that Are Essential and Desirable

BY ROY PAGE
General Superintendent Nebraska Power Company, Omaha

THE economical use of fuel is the most important factor in the efficient operation of a steam plant, no matter what kind of fuel is used nor what the size of the plant. Fuel, except in very small plants, is the major item in the cost of steam generation, and yet until the recent large increases in the cost of coal and oil it was the item of expense to which the least attention was paid. Most plant operators were content to purchase their fuel and turn it over to the boiler-room force with little or no instruction other than an order to maintain steam pressure. As a result fuel waste has been and still is large in most of the plants. To maintain any degree of efficiency in plant operation it will be necessary to purchase virtually all of the apparatus described in this article. But unless the boiler-room force is first convinced of the necessity and usefulness of the instruments and instructed in their proper care and use no increase in efficiency should be expected. These instruments are but tools, and without good workmen to handle them good tools are of very little use.

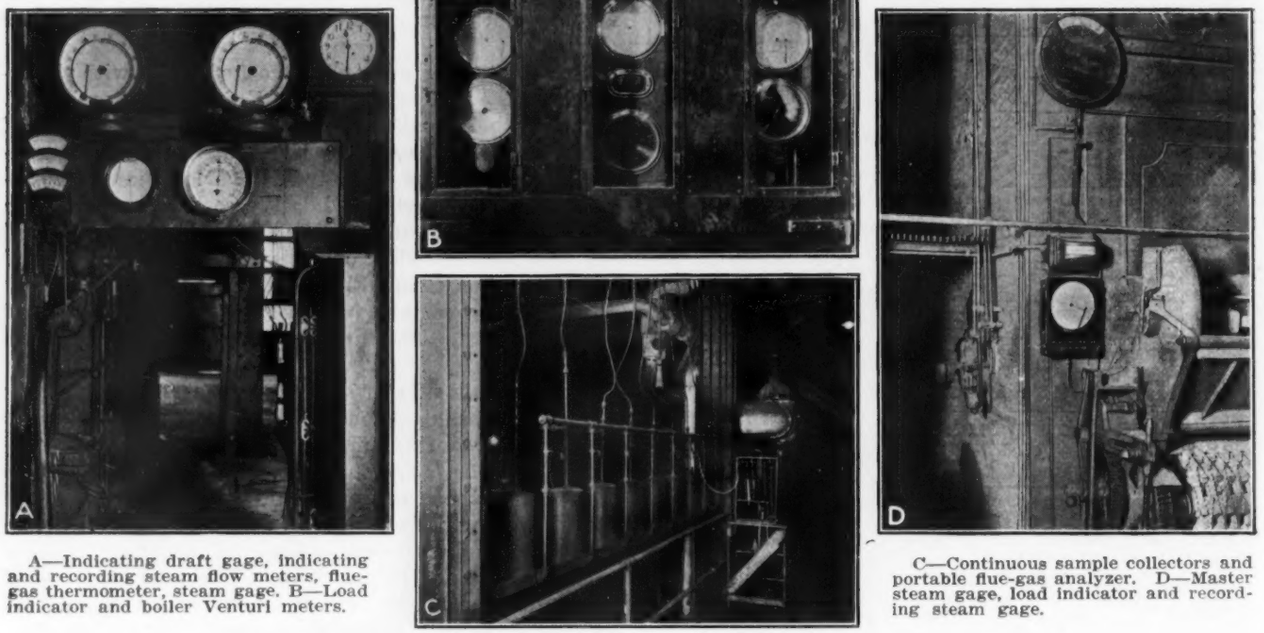
There are three things required to insure economy in the production of steam—first, an adequate supply of fuel of a uniform grade and of a kind fitted to the needs of the plant; second, an operating force capable of applying proper methods of burning the fuel, and, third, sufficient instruments of the proper sort to measure the results obtained and to guide the operating force in handling the equipment. Of course, the size of the plant will in some degree affect the refinements to which it is possible to go in the measurement of results, but unless there is *some* method of measurement only a guess can be made of the efficiency, and to guess that it is poor will not be far wrong in most cases.

It is important that care be exercised in the purchase of fuel, especially, as has already been said, with reference to uniformity and adaptability to the equipment in which it must be burned. In every case the price of the fuel should be carefully balanced against the efficiency which may be obtained with the type of equipment available.

Weight of Fuel.—In plants using fuel oil the process of arriving at the weight of fuel burned is comparatively simple. In most such plants it is obtained by gaging a calibrated tank.

In coal-burning plants obtaining the weight of fuel is not such an easy matter. Especially is this true in smaller plants, which cannot afford an installation of high-priced weighing equipment. Some method, however, should always be provided to obtain as accurately as possible, at least once a month, the weight of coal supplied to the boilers. Volumetric measurements (with so-called "coal meters") have been found satisfactory in hand-fired plants using fine coal. The careful use of railroad weights, in conjunction with accurate measurement of amounts in storage and bunkers, is also effective as well as inexpensive, and this method may be employed in plants of any size. Automatic coal scales for stoker-fired plants are good unless the fuel is of a type which will rapidly corrode the scales and throw them out of adjustment. Other methods are available, and one should be chosen which will give the most accurate results consistent with the size of the plant.

Heating Value of Fuel.—While the heat content of the fuel is not essential in arriving at the cost of the steam generated, before efficiency of the boiler plant can be figured it will be necessary to ascertain the average heat content of the fuel burned. This is not only an interesting figure, but it is absolutely essential if it be desired to discover where losses are taking place and to improve the efficiency of operation.



A—Indicating draft gage, indicating and recording steam flow meters, flue-gas thermometer, steam gage. B—Load indicator and boiler Venturi meters.

C—Continuous sample collectors and portable flue-gas analyzer. D—Master steam gage, load indicator and recording steam gage.

INSTRUMENTS WHICH ARE NECESSARY AS A GUIDE TO EFFICIENT OPERATION

Some method should be installed, as nearly automatic as is practicable, to obtain a sample of fuel which will reflect the average heat content of the fuel burned. Great care must be used in the collection and preparation of this sample; it is the method of sampling and not the laboratory analysis which introduces the greatest inaccuracies. Full instructions on how to take and prepare a coal sample for laboratory test have been issued by the Bureau of Mines. The sample obtained should be sent to a reliable laboratory where the proximate analysis and the heat-content can be accurately determined.

In the plant with which the writer is connected it has been found most satisfactory to prepare a sample of each day's run and then to combine these samples at the end of the month to produce the average for the whole period.

Good Methods of Measuring Boiler-Feed Water.—The amount of feed water evaporated should be carefully ascertained. There are many devices on the market for measuring the weight of the water supplied to the boilers. Among them are the "V" notch meter, the volumetric (or dumping-type) meter and the Venturi or other type of differential pressure meter. All these methods are good, and the one most suited to the plant in question should be chosen. Whatever meter is installed should be regularly inspected, so that it may be depended on to give accurate results.

Indicating or, more preferably, recording thermometers should be provided to give a record of the average temperature of the feed water as supplied to the boiler. Some method should also be provided to keep a check on the number of blow-offs made, as the amount of such blow-offs must be deducted from the results indicated by the feed-water meter in order to arrive at the actual evaporation.

Automatic feed-water regulators may be provided, but, if applied, those in charge of boiler operation should have instructions to watch the water as carefully as though no regulators were used. They should be considered more in the light of devices to regulate the supply of water to the boiler than as something to relieve the attendant of the duty of watching this detail of operation.

Each boiler, of course, should be provided with an accurate indicating steam gage. If there are a number of boilers, there should also be a large dial gage on the main steam header. A recording steam gage on the header is also a very desirable instrument.

If the size of the plant will warrant it (and there are few plants which will not, if efficiency is to be maintained), each boiler should be equipped with an indicating and recording steam-flow meter. This instrument is very valuable in indicating the steaming rate of the boiler and recording whether or not instructions in the operation of the boiler have been carried out.

There should also be provided in the main steam header an indicating or recording thermometer to give a record of the average temperature of the steam supplied to the prime movers.

Combustion Instruments.—Each boiler should be equipped with a draft gage, which should be arranged to measure the draft over the fire and the draft at the boiler side of the damper. The gages should be mounted so as to be readily visible to the fireman in the performance of his duties. If forced draft is used, a pressure gage to indicate the blast pressure under the fire will also be necessary.

A flue-gas thermometer (pyrometer), either indicating or recording, should be mounted in the uptake to the breeching, so that a careful record may be kept of the temperature of the gases leaving the boiler.

To obtain samples of the flue gases for CO_2 determination it is desirable to have some type of continuous sampler, which may be adjusted to take samples over periods of from fifteen minutes to eight hours. Portable Orsat apparatus should be used in conjunction with such a sampler and for taking snap samples when necessary.

Refuse Samples.—A very considerable part of the fuel lost in boiler operation is due to the combustible which is contained in the refuse. This is especially true when it is necessary to operate the boilers at high ratings. It is advisable to take frequent samples of the refuse and have them tested for the percentage of combustible. This loss may be very large even though the gas analysis and other conditions may indicate a high state of combustion efficiency.

Operating Results of a 1,500-Kva. Automatic Hydro Station

Reliability, Low Operating Costs and Absence of Labor Difficulties Potent Reasons for Automatic Operation —Experience of Iowa Railway & Light Company

BY T. A. E. BELT

Lighting Engineering Department, General Electric Company

THE rapid growth of the electrical industry may be credited to the fact that central stations as a whole have given efficient service and have generated cheap energy, but since the efficiency of labor in the last few years has greatly decreased, this efficient service has been challenged, particularly in localities served by the small or medium-sized station where high-grade operators cannot be maintained. If water power is the

DATA CONCERNING AUTOMATIC GENERATING PLANTS

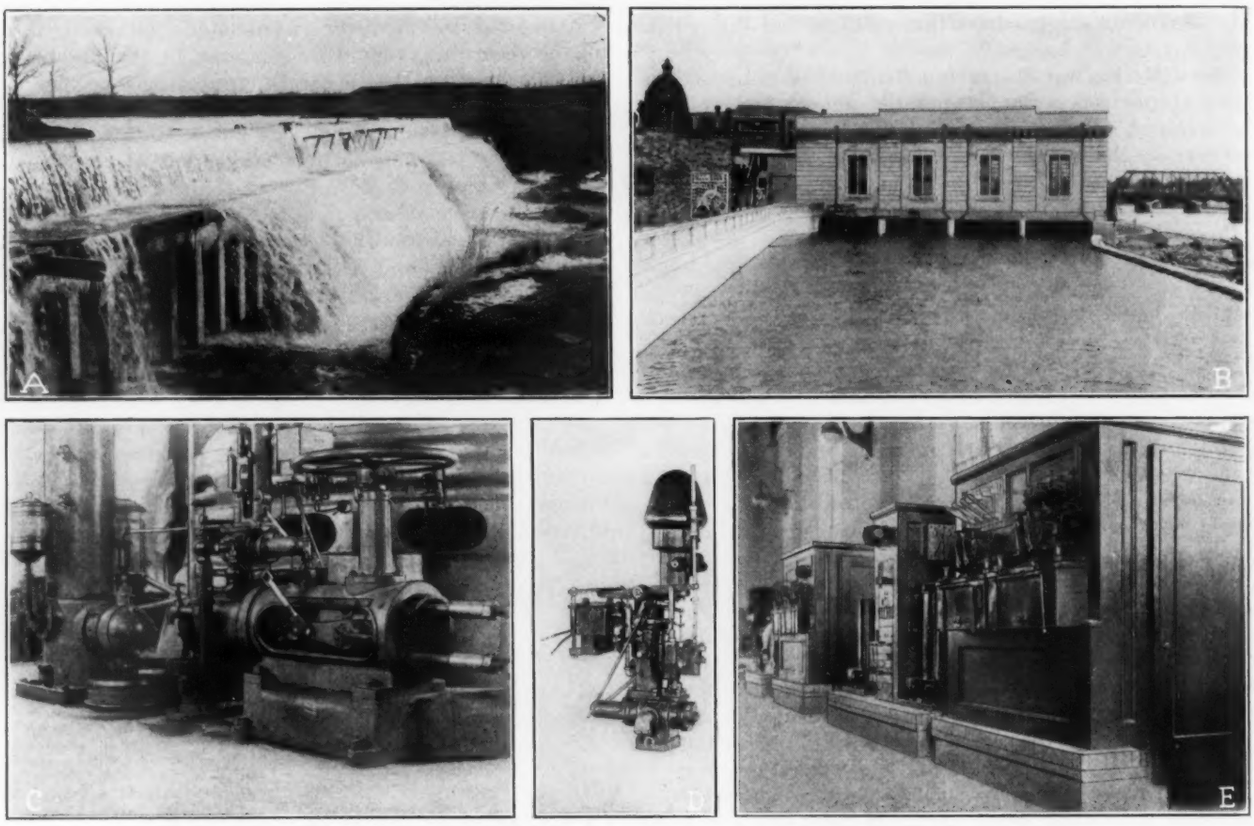
Company	Location	No. of Units	Kva., Each	Type of Generator	Voltage	Frequency	Master Starting Element	Year Installed
Iowa Railway & Light Co.	Cedar Rapids, Iowa	3	500	Synchronous	2,300	60	Float or remote hand switch	1917
Ontario Power Co.	Ontario, Cal	1	500	Synchronous	11,500	50	Remote hand switch	1919
Blue River Power Co.	Seward, Neb	1	240	Synchronous	2,400	60	Combination float and load switch	1921
Iowa Electric Co.	Manchester, Iowa	1	125	Synchronous	2,300	60	Float switch	1921
		1	75				Load switch	On order
Holyoke Water Power Co.	Holyoke, Mass	1	625	Synchronous	6,600	60	Energize line	1921
Burkhardt Milling Co.	Hudson, Wis	1	375	Synchronous	2,300	60	Remote hand switch	On order
International Paper Co.	Corinth, N. Y	1	625	Synchronous	600	40	Remote hand switch	On order
J. & J. Rogers Co.	Ausable Forks, N. Y	1	500	Synchronous	2,300	60	Remote hand switch	1921
Cazenovia Electric Co.	Cazenovia, N. Y	1	225	Synchronous	2,300	60	Remote hand switch	On order
Cheboygan Elec. Power & Light Co.	Cheboygan, Mich.	1	240	Synchronous	2,300	60	Float switch Energize line	On order
Hayden Milling Co.	Tecumseh, Mich	1	312	Synchronous	2,300	60	Energize line	On order
Keene Gas Electric Co.	Keene, N. H	1	150	Synchronous	2,300	60	Energize line	On order
Washington Water Power Co.	Spokane, Wash	1	12,750	Synchronous	4,200	60	Remote hand switch	On order

source of energy in these districts, the reliability of the large stations able to maintain high-grade operators may be assured by equipping the small stations with automatic control, for so equipped the plant is operated by the skillful engineer who has designed and built its control equipment.

After three and one-half years of operation of the 1,500-kva. automatic hydraulic plant at Cedar Rapids, Iowa, the Iowa Railway & Light Company, which owns the station, has made a statement showing that its automatic plant is more reliable than its hand-controlled stations and that the future policy will be not only to equip present plants with automatic control but to make all hydraulic developments automatic. The statement, in price and decrease in efficiency. The plant, from a financial standpoint, would not have been practically interesting if burdened with an additional labor charge of not less than $3,600 per year and probably, at the present prices, at least $4,800 per year.

"The inspection given the station is the cleaning of the trash racks each day by one of the boiler-room oilers who stops there and cleans off the racks on his way to work. The time required for the work is about thirty minutes. An electrical and mechanical inspection is given the plant once each week, requiring approximately two hours.

"The maintenance and operating charge of the station has averaged about $178 per year. The energy



RELIABLE AND ECONOMICAL SERVICE IS FURNISHED TO SMALL COMMUNITIES BY AUTOMATIC HYDRO-ELECTRIC STATIONS

A—Dam and storage reservoir for an automatic station of the Blue River Power Company recently installed at Shestak, Neb.
B—Automatic station of the Iowa Railway & Light Company at Cedar Rapids, Iowa, which requires negligible maintenance.
C—Governor mechanism in the Blue River station.
D—Automatic starting mechanism for automatic hydro-electric plants.
E—General view of main control board at Cedar Rapids plant.

which emphasizes the fact that "relays never sleep," follows:

"We have found from experience that the operation of the automatic station is more satisfactory and more reliable than the hand-controlled station, owing to the reason that the relays never sleep. We would not consider installing another hand-operated station and are changing over our hand-operated stations to automatic stations as fast as money will permit."

Of almost equal importance with efficient service is the cost of energy. A small or medium-sized plant burdened by a large operating expense is not an attractive proposition as the rates for power existing today are in most cases based on conditions which prevailed before the war. The Iowa Railway & Light Company says: "Our reason for selecting automatic control equipment was that we recognized that labor would increase generated is approximately $7,500,000 kw.-hr. per year."

In addition to the inefficiency and the high cost of labor, one operating company has a third reason for installing automatic generating stations. It is on account of inability to keep operators on the job. The plants are situated in the country, in some cases several miles from a town, and operators will not stay at a station for any length of time. These plants when automatically equipped will come into service at peak load, differentiating on water level; that is, the stations where the water level is the highest will be the first to come into service on load demand, the other plants waiting until the load further increases.

The Iowa Railway & Light Company, in referring to its automatic station, states:

"The cost of delivered energy is based on the interest charges of the plant plus the maintenance and operat-

ing cost. The total fixed charges against the plant are about 12 per cent, based on the price of money when the plant was constructed."

The cost of the 1,500-kva. plant was approximately $280,000; therefore the yearly fixed charges against the plant are $33,600. The additional yearly operating and maintenance charges of $178 make a total yearly charge against the plant of $33,778, which, based on an output of 7,500,000 kw.-hr., gives a cost for delivered power of 0.45 cent per kilowatt-hour.

The table shows that the advantages and practicability of automatic hydro-electric stations are now being recognized by other companies.

Maintenance Handled in Central Shop on Southern System

Station Operators Not Allowed to Make Repairs—Central Shop Handles All Maintenance Work—Sufficient Force Maintained to Meet Any Emergency

BY GEORGE A. ILER
Superintendent of Operation, Tests and Repairs, Georgia Railway & Power Company, Atlanta

SEVERAL years ago the Georgia Railway & Power Company centralized its repair force, establishing its headquarters in the same location with the electrical laboratory. The repair shop is kept open continuously, including nights and holidays, and is in direct touch with every station on the system. In order to co-ordinate the repair men's work with the load dispatcher's requirements, virtually all shop telephone traffic is routed through the load dispatcher's office. In this way the repair shop is able to determine whether certain equipment will be available for repair and whether it can be spared or not at off-peak times.

The central shop handles all repair work from the smallest job to the largest, which includes the building of stations, repairs of transformers up to and including those rated at 3,333 kva. and 110,000 volts, the repairing of all burned-out rotaries and generators and the testing of this equipment when repairs are completed.

MANUFACTURING CARRIED ON AS SIDE LINE

As a part of its work the repair shop carries on enough manufacturing work in the central shop to make available always a sufficient working force to handle any emergencies that may arise. At such a time the manufacturing work is temporarily discontinued and all of the men are used to make rapid repairs by placing two or three shifts on the work. In this way a repair job can be carried on continuously until it is finished, when the men go back to the manufacturing work. Work which is carried on in this way is the manufacture of angle blades, disconnecting switches, live-line tools, reclaiming old oil, cabinet work, repairing of office furniture, etc.

Reclamation work is another important feature of the central repair shop and is carried on by the same force of men. This work consists of the continuous process of gathering new and old materials that are left lying about the numerous stations by the construction or other crews and bringing the collection into the repair shop, where it is renovated or reconditioned before it is placed back in stock. Such work is also handled on what is really a commercial basis; that is, all departments within the company sell their old material to the reclamation department for the price of junk or, in some cases, the price of badly used second-hand material, and after the repairs have been made the material or equipment is placed in stock and sold at the prevailing market price.

There are numerous substations and power plants in the vicinity of the city of Atlanta within a radius of 7 miles, this territory being known as the "seven-mile zone." If at any time trouble should occur at any of these stations, the load dispatcher is immediately notified by the station operator, and the dispatcher in turn transmits the information to the proper subdivision of the test and repair department. Quite often, owing to the nature of the trouble, the men from the testing department are required to get on the job first in order to locate the trouble before the repair crew starts in to work.

It has also been the policy of the company to store all spare parts for electrical equipment at a central point, keeping a proper record of this material or equipment so that it will be available at a moment's notice. Before this system was placed in operation an occasion arose where a spare set of collector rings for a 2,000-kw. railway rotary was needed. These collector rings had been purchased and very carefully laid away to take care of any future emergency, but had been on hand so long that there was only one man connected with the company who knew where they were. Unfortunately this man could not be found, and therefore a general search for the rings had to be instituted. This kept several men busy for an entire day and night opening boxes until the rings were finally located. An incident of this sort could not happen with the present system of carrying spare parts at a central point where it is possible to have them properly boxed or crated and numbered and a card-index record kept showing where they may be found.

In this maintenance system the station operators are not allowed to make repairs of any description, it being the belief that the operator's entire time is required in watching the station instruments, controlling the machines, looking for hot bearings, taking semi-hourly log-sheet readings, answering the telephone, and in general keeping his mind on the operating conditions. It was felt that if he were required to do minor repairs he would have a legitimate excuse to slight some of the above-mentioned duties. It was also found that if operators at the different stations were allowed to perform their own minor repairs, each one would have his own way of doing the work and would have an individual idea of what constituted the proper electrical repair. There would also be a variety of ideas as to what a neat workmanlike job looked like. Furthermore, if the operators were required to make such repairs, it would mean that each station would have to be equipped with a complete outfit of tools, blowtorches, repair parts, etc., which would entail considerable expense. Even so the equipment would not be as complete as might be provided at a central repair shop, and therefore the operators or local utility men could not be expected to do as good work.

By having all the repair men centrally located it is possible to have groups of men who are trained to do certain kinds of work as specialists, and further it is possible to have the work done with uniform standards.

Another feature which has been found valuable is that of holding a service truck ready for an emergency when the dispatcher has been informed that a storm is moving toward one of the large power centers.

Interconnection Problems and Economies

INTERCHANGE OF ENERGY between plants and even between systems has been proved to be profitable and practical. Progressive companies are not overlooking the economies which may be effected by tying in with their neighbors. The problems are chiefly in providing switching and protective facilities and mutually agreeable interchange arrangements.

Charts for Quick Solution of Line-Drop Problems

By Means of Two Sets of Curves Voltage-Drop Calculations Can Be Graphically Made with Sufficient Accuracy for Practical Purposes

BY E. P. PECK
General Superintendent Electrical Department, Utica Gas & Electric Company

ENGINEERS are continually being called upon to make calculations on transmission lines of different voltages, lengths and sizes of wire, to carry different loads at all distances with different wire spacing, when there is not sufficient time available to make the mathematical calculations for exact solutions. Frequently they must give almost immediate answers to such questions as "What voltage will be required and what size wire will be necessary to carry x kw. y miles?" or, "Is it better to add load at this particular voltage, or will it be better to use another voltage, as there is a possibility of load increasing to perhaps 300 per cent of that carried at the present?"

To make it possible to answer such questions promptly a large amount of time has been spent in the attempt to reduce all transmission-line calculations to data which could be put on one sheet and made very simple to use. While this result has not yet been accomplished, it has been found possible to cover the eight most common sizes of wire with two charts, which will give very closely the voltage drop obtained with these eight sizes of wire with any load at any distance, with power factors from 50 to 100 per cent and line voltages of any value. Two such charts are reproduced in the insert which appears elsewhere in this issue. These charts cover all commercial voltages from 110 to 110,000, and constants may be computed for any other voltage without the use of a pencil. A number of checks have been made on the values computed from these charts, and it has been found that with virtually all loads, distances up to 100 miles (160 km.) and voltages up to 110,000, the charts give less than 2 per cent error, and in very few cases, within the limit of 150 miles (240 km.), is the error as great as 3 per cent. This accuracy is very much higher than is required for any preliminary calculation, and in fact is as good as is desired on perhaps 95 per cent of the transmission and distribution lines. The sizes of wire covered are Nos. 4, 1, 2, 1/0, 2/0, 3/0, 4/0 and 250,000 circ.mils.

In the Jan. 16, 1915, issue of the ELECTRICAL WORLD H. B. Dwight gave a chart for calculating the regulation of transmission lines. This chart has been of material assistance in the past, and curves given here were made up largely from calculations based on H. B. Dwight's chart.

To use the chart it is necessary to assume some size wire, some load, some power factor, some distance and some spacing of conductors. Let us take a load of 3,000 kw. at 75 per cent power factor, at a distance of 15 miles (24 km.). We will assume a voltage of 22,000 and a wire size of No. 2/0. We wish to find the percentage of voltage drop.

On the No. 2/0 curve we find the vertical line for 75 per cent power factor, which is followed up to the intersection of the diagonal line giving wire spacing, which we will take as 3 ft. (0.9 m.). From this intersection we follow to the left and find that d is 9.15. To get the voltage drop we multiply d, or 9.15, by 3,000 kw. and by 15 miles (24 km.) and divide by a factor K, which is found in the table to be 20. V, or the voltage drop at the receiver end from no load to full load, is then 2,059 approximately. The percentage of drop referred to the no-load voltage is 9.35. This calculation is made on a slide rule in a few seconds, and it compares with a very long calculation if transmission-line formulas are used.

For lines of a length greater than 50 miles (80 km.) the voltage at the receiver end is appreciably higher with no load than the voltage at the generator end. The correction at 50 miles is approximately 0.5 per cent and may be neglected. The correction at 100 miles (160 km.) becomes approximately 2.1 per cent, and at 150 miles (240 km.) approximately 4.85 per cent. The distance-correction curve given at the corner of the chart is merely the percentage voltage rise along a transmission line when there is no load on the line, for a line of average characteristics as to size of conductor, spacing of conductors, etc. It is thus approximately correct for any voltage or any spacing of conductors. This correction need not be made if only the regulation or change in voltage at the end of the line is desired. The correction is applied when it is desired to get the drop in voltage from the generator to the receiver with load applied. Thus after having obtained the percentage drop in voltage at the receiver end from no load to full load from the main chart the distance-correction curve is applied by subtracting the per cent correction. The voltage at the receiver under load may be found to be lower or higher than the voltage at the generator.

The conductor spacings are taken at sufficient intervals to allow interpolation for any conductor spacing. The spacings given are effective spacings, which correspond with the line spacing if wires are arranged in the triangular position. With flat spacing the distance between adjacent wires is multiplied by 1.26 to get effective spacing, or if the conductors are irregularly spaced it is necessary to take the cube root of the product of the conductor spacings. All of this information is given in formulas on curve sheets.

Conditions that Must Be Watched When Interconnecting Small Plants

When Small Generating Plants Are Tied in with Larger Systems the Rupturing Capacity of Switches Becomes a Very Important Consideration

BY HARRY J. BURTON
Consumers' Power Company, Jackson, Mich.

WHEN plants of relatively old design are tied by means of transmission lines to systems or plants of larger capacity it should be kept in mind that the simple operation of opening and closing a switch under load may produce results entirely different from those that could occur before the interconnection was made. Sometimes the short-circuit current may be increased above the interrupting capacity of the existing circuit breakers as well as above the mechanical strength of busbars, current transformers and other apparatus. Consideration of these facts is peculiarly important because death has marked several recent disasters that have occurred in or around power stations when large volumes of electrical energy have broken loose.

SYSTEMS SHOULD BE STUDIED BEFORE INTERCONNECTING

Before additions or interconnections to an existing system are considered a study should be made to determine the possible short-circuit current with a view to providing proper spacing of conductors, adequate interrupting capacity, suitable current-limiting apparatus and relay protection. Methods have been devised for calculating system short circuits so that it is possible to predict them with great accuracy. Furthermore, oil circuit breakers have been designed with large interrupting capacity. By selective action of oil circuit breakers, supplemented by current-limiting reactors or segregation of portions of the system and the proper use of relays, it should be possible in most cases to protect the system and cut off the short circuit without serious damage.

While many appear inclined to the belief that the simplification of circuits and control is the only requirement in assuring satisfactory operation of heavily loaded circuits, the control of such large concentrations of power presents very difficult problems. The electromagnetic stresses and abnormal temperatures set up are enormous. The cutting out of relays to prevent switches from tripping when a short circuit occurs is, in the author's opinion, like the proverbial blocking of the safety valve. Some of the larger companies are growing so fast that they have outgrown their circuit-breaker capacity and are segregating portions of their system, at least until adequate circuit-breaker capacity is installed. Other companies are installing circuit breakers with a rupturing capacity of 1,000,000 kva. or more and in addition are using current-limiting reactors and segregation methods.

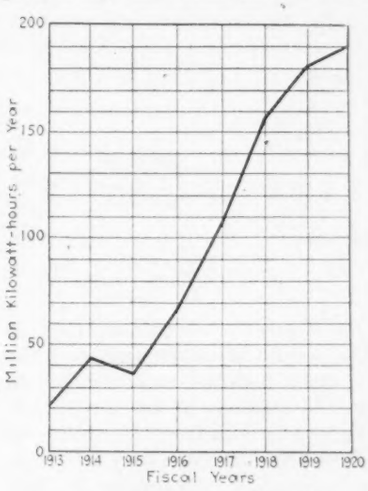
True economies are obtained and the utmost gain is realized only when every known or possible element of hazard that may tend to destroy life or property is considered. If it is not possible to make a system reasonalby safe because of its size, the economic limit has been reached. If oil circuit breakers or other protective apparatus cannot be designed at a reasonable cost to protect life and property adequately, they are the weak links in the chain and limit the economic size of a system. Precautionary measures, whether included in the scope of initial design or in the application of safety plans, are of equal importance and operate in the same direction as regards protecting the capital investment.

From what has been said it should not be inferred that large electrical systems are unsafe and costly to operate. The contention is that careful consideration should be given to the various factors. Some of the questions which must be answered in dealing with this problem are the following: Is the danger line approached because of uncertain factors? Are all the parts that go to make up a modern electrical system keeping pace with the development? Are engineers on the right track in their attempts to interrupt suddenly currents of several million kilovolt-ampere capacity? What is the economic limit to the size of a system?

Economic Benefits Derived from Energy Interchange

Massachusetts Central Stations Have Interchanged 800,000,000 Kw.-Hr. in Past Eight Years at a Net Price Below Half a Million Dollars

THE rise of interconnection among neighboring central stations is one of the most significant developments of the past decade in the public utility field. The advantages of energy interchange are now widely appreciated, and even the non-technical public has some conception of the underlying reasons why interconnection may be worth while. Rarely does the central station seeking the right to "tie in" with another system meet serious opposition before the legislative, municipal or commission authorities concerned, provided that pains have been taken to set forth clearly in the press and otherwise the gains expected from plant interlinking. Massachusetts central stations afford an interesting illustration of interconnection development from year to year. Many companies operate in a comparatively small area intensively developed and containing cities and towns embracing highly diversified manufactures and business enterprises. Residential use of electricity is rapidly increasing all over the state. Electric railway development of large importance affords bulk loads. Energy produced by hydro-electric plants is fed into systems supplied by steam-driven stations, and vice versa. The neighboring systems are near enough in many cases to permit interconnection at moderate and even nominal cost of line construction. The network of interconnected lines built up within the past few years covers practically all of central and eastern New England, and in a sense operations in Massachusetts form a cross-section of the larger district's activities. The growth of interconnection was indicated in the ELECTRICAL WORLD of May 8, 1920, the principal high-tension lines and connected plants being mapped in that issue.



GROWTH OF ENERGY INTERCHANGE BETWEEN MASSACHUSETTS CENTRAL STATIONS

The central stations of Massachusetts interchanged 191,038,868 kw.-hr. in the year ended June 30, 1920, making the total interchange for the past eight years 807,053,479 kw.-hr. The rate of increase in interconnected delivery of energy was 6 per cent, compared with 13.4 per cent the previous year. Sixteen interconnections were utilized for mutual interchange, and the participating companies delivered in one direction 119,102,072 kw.-hr. and received from the other direction 71,936,796 kw.-hr. Many companies also sold to or purchased energy from others, but the above total covers interchange operations and not straight supply operations. The average price paid per kilowatt-hour of energy purchased was 1.08 cents and per kilowatt-hour sold 1.12 cents. The total energy, 191,038,868 kw.-hr., changed hands at an average price of 1.09 cents; but since the companies paid $1,287,545 and received $804,584 for the energy interchanged, the net outlay was but $482,961, or 0.25 cents per kilowatt-hour.

The accompanying table, compiled from returns of the several companies to the Department of Public Utilities, exhibits a wide diversity of transactions in energy interchange. The amounts of energy and the prices paid vary greatly, from nominal interchanges to mutual supplies running into millions of kilowatt-hours for the year. It none the less is true that the ability of each company concerned to furnish electricity at times when it is to another company's advantage to buy justifies variations in price for energy received as against energy delivered. As a rule hydro-electric companies purchasing from steam plants were obliged to pay from 2 mills to 9 mills more per kilowatt-hour than the steam-operated central stations paid for water power. This was no doubt due to the market value of surplus or secondary hydro-electric power available at different periods and also to the high cost of fuel. The opportunities interconnection affords for taking advantage of load-factor conditions are being utilized in virtually all these cases.

INTERCHANGE OF ENERGY IN MASSACHUSETTS CENTRAL STATIONS FOR THE FISCAL YEAR 1920

Interchange		Purchased from (B)			Sold to (B)		
Company A	Company B	Kw.-Hr.	Price	Cents per Kw.-Hr.	Kw.-Hr.	Price	Cents per Kw.-Hr.
Amesbury	Newburyport	3,920,000	$53,422	1.364	36,710	$231	0.63
Central Mass.	N. E. Power	11,962,018	167,203	1.39	1,065,881	10,275	0.9
Boston Edison	N. E. Power	7,125,257	33,101	0.46	11,560,822	155,820	1.35
	E. Mass. El.	646,700	9,080	1.40	3,430,000	50,726	1.48
Greenfield	Turners Falls	2,986,000	34,803	1.655	1,464,000	7,320	0.5
N. E. Power	Adams	10,273	327	3.06	1,337,700	20,218	1.51
	Athol	4,675	51	1.10	5,144,777	58,482	1.14
	Fitchburg	2,362,400	34,727	1.47	2,304,309	34,435	1.49
	Marlboro	2,500	176	7.07	4,475,817	60,094	1.34
	Turners Falls	37,195,740	260,120	0.70	440,500	4,277	0.97
	Worcester E. L.	12,135,395	130,511	1.08	5,335,520	28,587	0.54
Malden	E. Mass. El.	18,953,500	318,238	1.679	5,660	134	2.37
Salem	E. Mass. El.	48,000	2,429	5.06	23,490,000	284,406	1.21
Turners Falls	Springfield	17,733,200	161,890	0.91	11,832,800	89,197	0.754
Adams	No. Adams	157,864	4,792	3.04	10,200	255	2.50
Revere	E. Mass. El.	3,858,100	76,675	1.99	2,100	127	6.06
Totals and averages		119,102,072	$1,287,545	1.08	71,936,796	$804,584	1.12

The low cost of water-power delivered under favorable conditions is very striking. Thus the Boston Edison company received 7,125,257 kw.-hr. from the New England Power Company at a total cost of only $33,101, or 0.46 cent per unit; the Worcester Electric Light Company received 5,335,520 kw-hr. from the New England at 0.54 cent per unit, and the United company, Springfield, received 11,832,800 kw.-hr. from Turners Falls at 0.754 cent. At present steam-generating costs such arrangements are very much worth while, for in this way any surplus of water power helps to reduce the cost of supplying energy on the steam systems, and the co-ordination of generating equipment and loads on both types of systems enables more reliable service to be rendered and at a lower cost than would be feasible with independent operation. In passing, the almost perfect balance between the Fitchburg and New England companies may be noted, both as to interchange and prices. The existence of an unbalanced-energy account, however, by no means indicates an inefficient interconnection. The price of efficiency, none the less, is engineering skill, operating intelligence and economic insight.

That interchange is aiding plant operation from the economic standpoint is indicated in the fact that in 1916 eleven representative Massachusetts systems, with a total station rating of about 198,000 kw., handled 384,000,000 kw.-hr. at the bus, whereas in 1920 these companies, with about 330,000 kw. rating, handled 756,000,000 kw.-hr. at the bus. That is, in 1916 these plants handled 1,940 kw.-hr. per kilowatt of station rating and in 1920 they handled 2,290 kw.-hr. per kilowatt of station rating, a gain of 18 per cent in equipment utilization.

It is conservatively estimated that the interchange of energy among the Massachusetts stations listed in the table saved from 75,000 tons to 100,000 tons of coal during the fiscal year 1920, and there is good reason to believe that interchanging energy is saving these companies over a million dollars a year in operating costs and fixed charges.

Finland's Wealth of Water Power

AN IMPORTANT factor in the industrial development of Finland is the exploitation of its wealth of water power. The potential output of power from hydro-electric sources, chiefly from waterfalls, is estimated at 3,000,000 hp., to which the River Ulea and the rivers south of it contribute 1,200,000 hp. A considerable part of this water power is owned by the state. Among the important water-power resources entirely or partly in possession of the state are the following: Vucksen Falls, 300,000 hp.; Imatra Falls, 211,000 hp.; River Ulea, 542,000 hp.; Pyhäkoski Falls, 100,000 hp.

The output from existent hydro-electric power plants is only 170,000 hp., but the Finnish government seems determined to promote the exploitation of water power energetically. Finnish manufacturers, however, cannot supply the necessary machinery and electrical equipment, and for these foreign countries must be looked to.

Distribution Service in Rural Districts

SOME COMPANIES may not have considered this service a profitable business because of the long lines required to serve widely separated loads. However, several companies in the middle and far West have built up large and profitable loads by proper consideration of financing and service expenses.

Serving Dense Irrigation Load in California

Rapid Growth of Load Called for Revision of the Distribution System to Improve Service—Calculating Voltage Drops.

BY EDWARD N. D'OYLY
Superintendent of Electric Distribution Western States Gas & Electric Company, Stockton, Cal.

ONE of the richest and most intensively cultivated districts in San Joaquin County, California, is that surrounding Lodi, about 15 miles (24 km.) north of Stockton. The crop value from this district in 1920 was $20,000,000, which was made possible only by intensive irrigation done by electric pumping. There is an abundant supply of water to be had at a depth of from 20 ft. to 50 ft. (6 m. to 15 m.) below ground level, and almost every farmer has his individual pumping plant. Electrical energy in this district is supplied by the Western States Gas & Electric Company, which gives service to 2,214 consumers, of whom 2,000 are power consumers. A 4,600-volt distribution system is employed to feed the district, the transformer stations ranging in capacity from 1 kva. to 150 kva. Within a 6-mile (9.6-km.) radius of one substation are 1,991 transformers having a total capacity of 11,382 kva. It is believed that the number per square mile is greater than in any other rural district of equal area.

Heretofore one substation rated at 3,000 kva. at the center of the load supplied the whole district. The transmission voltage of 60,000 was stepped down in two 1,500-kva. banks of transformers to 4,600 volts, and four feeders, each equipped with a 10 per cent boost-or-buck induction regulator, carried the load. The remarkable increase in demand last summer so overloaded these feeders that immediate steps had to be taken to improve the service. A detailed study of the system was made with a view to determining the most desirable way of handling the situation.

At the outset a maximum voltage regulation of 10 per cent at the terminals of any motor was decided upon, since the frequency is maintained constant at 60 cycles and all motors are guaranteed to operate satisfactorily at normal frequency and with applied voltage 10 per cent above or below normal. Measurement of current, voltage and power factor were made at the substation and at various points along the feeders. From these data empirical relations, such as the ratio of maximum feeder current to kva. of distribution transformers, were established as a basis for calculation. Four schemes for the improvement in service were then worked up.

The first proposition involved increasing the size of the present feeders, maintaining the voltage at 4,600. This proved impracticable as it would have been necessary to string 500,000-circ.mil. cable for the 1925 load.

The second scheme contemplated connecting the low-tension side of the substation transformers in star to give a feeder voltage of 8,000. The State Railroad Commission, however, has issued an order restraining power companies from operating double-starred transformer banks on transmission lines involved in parallels with telephone or other communication circuits. To comply with the ruling it would have been necessary to purchase new transformers with tertiary windings or with primary wound for 60 kv., since all of the transformers are wound for 34,650 volts primary and are star-connected to the 60-kv. lines. Furthermore, with 8,000 volts on the feeders, it would be necessary to interrupt service when installing new transformers or extensions, whereas in this system the 4,600-volt feeders are handled when alive.

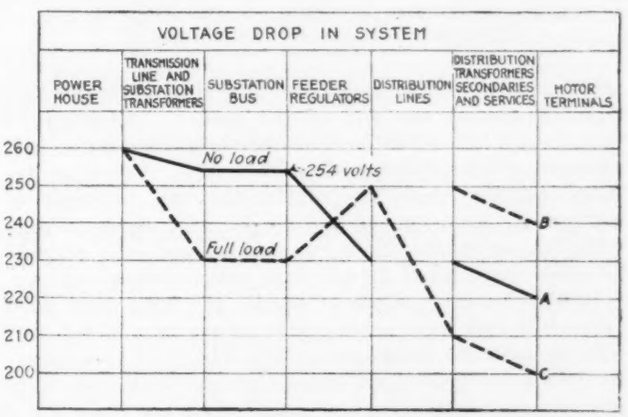


FIG. 1—VOLTAGES ON TRANSMISSION AND DISTRIBUTION SYSTEM SERVING THE LODI DISTRICT

All voltages are expressed in 220-volt terms. *A* is the voltage on all motors when the system is lightly loaded; *B* is the voltage on motors near the substations, and *C* is that on motors at the ends of feeders when the system is fully loaded.

Proposition No. 3 involved a system of 11-kv. feeders running to eight centers of distribution, where the voltage would be stepped down to 4,600 to feed the present system. Since all station transformers purchased during the last few years are designed for secondary voltages of 11,000, 4,600 or 2,300, this proposition proved more desirable than either of the first two, but was abandoned in favor of the fourth scheme, which was finally adopted.

This plan was that of building additional 60-kv. substations and extending the transmission line, where necessary, to feed them. Preliminary computations indicated that induction-feeder regulators would be necessary, and the chart shown in Fig. 1 was drawn up

to show the maximum over-all voltage regulation allowable from power house to motor terminals. At no load on the system taps are chosen on the primary of the substation transformers to give a bus voltage of 5,080. The feeder regulators lower this voltage to 4,600, which is maintained throughout the feeder. A drop of 10 volts is allowed in distribution transformers, secondaries and service, giving 220 volts at motor terminals. At full load on the system the bus voltage will drop to 4,600, and feeder regulators will raise this to 5,000 volts at the substation. The maximum permissible drop in

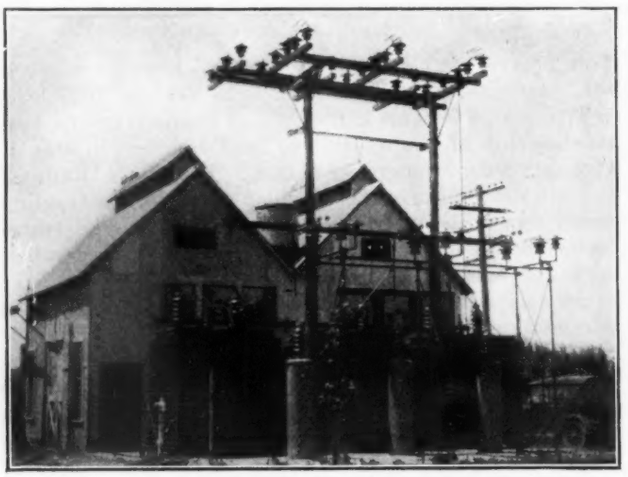


FIG. 2—ONE OF THREE SUBSTATIONS FOR SUPPLY OF THE GRAPE-GROWING INDUSTRY NEAR LODI, CAL.

any feeder is limited to 800 volts, giving 4,200 volts on transformers at the end of the feeder. Allowing 10 volts drop in distribution transformers, secondaries and services, motors will operate at 200 volts. Consequently those motors near the substations will operate at voltages between normal and 10 per cent above normal, while those at the ends of the feeders will operate between normal and 10 per cent below normal voltage.

It was found possible to handle the 1921 load with two additional substations, although still another two will probably be necessary within the next two years. Locations for these were chosen at such distances from the original station that no copper heavier than No. 2 B. & S. would be required on the 4,600-volt feeders.

The 60/4.6-kv. transformers are placed outdoors, and space is provided for lightning arresters to be installed later. Duplex lead-covered cables are run in underground conduits from the low-tension bushings of the transformers to the inside of the building to six disconnecting switches mounted side by side. The delta connection is made just above these disconnecting switches. This made it possible to dispense with any structure built around the transformers to carry the heavy secondary leads, and in case of transformer trouble it is necessary only to open two "disconnects" and remove one primary fuse in order completely to disconnect the defective transformer. Provision is made in each building for handling four feeders of 75-amp. capacity. Each feeder is equipped with a 10 per cent boost-or-buck regulator and protected by an oil circuit breaker with overload release. Graphic wattmeters and voltmeters are installed to give continuous records of output and operation. The transformer capacities in the three stations comprise three 1,000-kva., three 500-kva. and three 333-kva. units, making 4,500 kva.

ANALYSIS OF VOLTAGE CONDITIONS ON A TYPICAL FEEDER

Section (Refer to Figs.)	Length, (Miles)	Size Feeder, B. & S.	Rating of Distribution Transformers, Kva.	Maximum Line Current, Amp.	Drop in Section, Volts	Volts at End of Section	Volts at Motor Terminal
a	0.25	2	790.5	49.4	26	4,774	229
b	0.5	4	775.5	48.5	71	4,703	225
c	0.5	4	730.5	45.7	67	4,636	222
d	0.5	4	491	30.7	45	4,591	220
e	0.5	4	460	28.8	42	4,549	217
f	0.5	4	155	9.7	14	4,535	217
g	0.27	4	116.5	7.3	5	4,530	217
h	0.7	6	49	5.0	15	4,515	216

Measurements of line current at different points on the various feeders gave the average ratio between maximum feeder current and kva. of distribution transformers connected beyond the point of measurement as one to sixteen. In other words, if a feeder carries 1,000 kva. of transformers, the maximum current demand will be 62.5 amp. The average diversity factor on the feeders is 50 per cent. Owing to the large number of transformers and the diversity of load, the power factor does exceed 75 per cent.

According to records taken at station No. 3 on April 22, 1921, the load factor is 74.5 per cent, which is an average for the district during the irrigation season. In figuring line regulation resistance of copper is taken at 149 deg. F. (66 deg. C.) and the equivalent spacing of conductors at 3.1 ft. (0.94 m.). Line drop at a power factor of 75 per cent can be expressed with close approximation as:

$$D = \sqrt{3}(R \cos \theta + X \sin \theta)$$ per mile per ampere.

This neglects the drop due to the out-of-phase component of impedance, which is small. The product of line current multiplied by D gives the drop per mile. Each feeder was divided into half-mile sections and the drop calculated on the assumption that the total current at the beginning of any section was carried throughout.

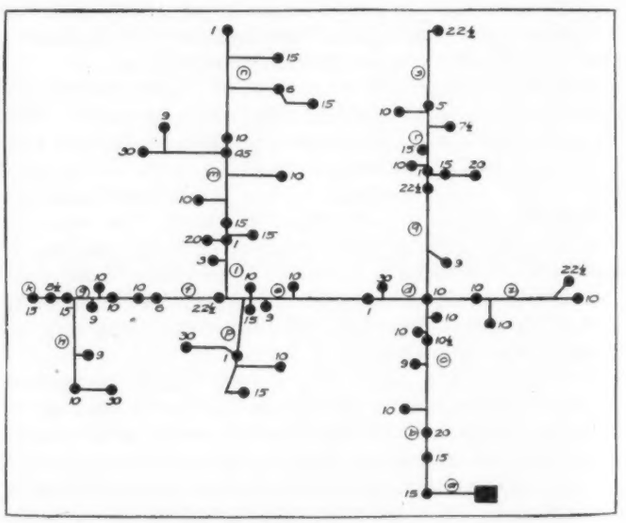


FIG. 3—TYPICAL FEEDER CIRCUIT SHOWING LOCATION AND SIZE OF TRANSFORMER BANKS

The drop at the end of any feeder must not exceed 800 volts, and wire sizes were chosen accordingly.

In order to maintain the standard of service desired, it was found necessary to increase the 60-kv. transmission-line capacity. Consequently it was decided to replace the original No. 1/0 aluminum conductor with

No. 2/0 stranded copper. In December the work of reinforcing the old poles and rebuilding the corners was started. By March 23 half of the new copper was strung, but the work had to be abandoned on that date on account of the irrigation load, which was increasing so rapidly that it could not be handled over the other line. However, since the reconstructed system is designed to carry the 1925 load no difficulty should be experienced in maintaining the desired voltage on all services during the 1921 season.

Rural Lines Owned by Farmers

Farmers Build, Own and Maintain Lines According to Minnesota Company's Specifications—Rates Include an Energy Charge and a Fixed Charge

BY C. S. KENNEDY
General Manager Otter Tail Power Company, Fergus Falls, Minn.

A LARGE demand for lines to serve farmers has developed in the territory covered by the Otter Tail Power Company, Fergus Falls, Minn. The lines are growing more popular every day, and it has become somewhat of a problem for the utility to know just how to care for the increase in this class of business. The system which this company has adopted has proved quite successful. Because of the favorable rates which can be given to the farmers they use energy for small motors and cooking ranges in addition to lighting.

The farm lines, operating at 12,000 volts or 6,600 volts, tap the company's 40,000-volt lines through transformers. The farmers build the farm lines and afterward retain possession of them. They own and maintain the lines and all equipment up to the point where the 40,000-volt line is tapped. The 40,000-volt transmission lines, about 400 miles (640 km.) in length, connect the plants of the Otter Tail Power Company to fifty-seven towns and villages in the States of Minnesota, North Dakota and South Dakota and traverse some of the richest farming communities in the three states. The plan now being followed is for a number of farmers to form a stock company and raise money enough to have a line built by a contractor which will serve all of the stockholders. The Otter Tail Power Company supplies the specifications under which the line is to be built so that all rural lines shall be uniform in construction. The rural line in most cases is built along the highway. Owing to the fact that the farmers have had to finance and build their own telephone lines, it has not been difficult to make them understand that the utility cannot make the investment and give rates for energy which would compare favorably with town rates.

SPECIFICATIONS FOR BUILDING RURAL LINES

Farm lines are either three-phase, four-wire, 12,000-volt Y, or single-phase 6,600-volt. The lines in general are constructed of three conductors and one overhead static wire. At each pole the conductors are supported on one 8-ft. (2.4-m.), three-pin cross-arm of 3¾-in. x 4¾-in. (9.5-cm. x 12-cm.) treated Washington fir. The static wire is attached directly to the pole just below the roof. Northern White Cedar poles, measuring 7 in. x 30 ft. (17.8 cm. x 9 m.), are used, being butt-treated and set 200 ft. (60 m.) apart. Pins are of steel with paraffined wood tops, and insulators are of porcelain, rated at 17,000 volts. Each conductor consists of either ¼-in. (6.3-mm.) double-galvanized steel wire strand or No. 6 seven-strand bare copper wire. The overhead static wire is a ¼-in. double-galvanized steel wire strand and is fastened to the pole by means of a 6-in. (15.2-cm.) galvanized three-bolt clamp, the middle bolt of which is replaced by a ½-in. (1.27-cm.) machine bolt passing through the pole. This static wire is grounded at every pole by means of a No. 8 galvanized-iron wire stapled to the pole its entire length, and the wire is carried zigzag at least four times across the butt end of the pole and stapled in place before the pole is erected. For substation equipment at the supply end of the 12,000-volt line there is used a triple-pole, 15,000-volt automatic oil-break switch. Three disconnecting switches are placed so as to isolate the substation equipment when the disconnecting switches are open. Lightning arresters and choke coils are connected on each phase to protect the substation equipment. Although the contour of the country influences the cost, the average is between $1,000 and $1,300 per mile.

Transformers are rated at 6,600/110/220-volts and protected by choke coils, lightning arresters, "disconnects" and fuses, mounted on the first pole away from the main line. The case of each transformer and the neutral of the 110/220-volt secondary are grounded.

Return postal cards are sent out each month on which each consumer may indicate the position of the meter dial hands and forward the card to the office so that the bill can be made out. This method of reading has been found very satisfactory, and it is only in rare instances that a card is lost or not returned. The bills are mailed direct to the farmer who pays by check or to his bank.

In case of trouble to services the farmer telephones to the nearest office or contractor, and all expense for time and material is billed to him.

FAVORABLE RATES FOR FARM SERVICE

Rates for service include the following provisions:

(a) A fixed charge to cover transformer losses as per the following schedule, which indicates the loss charge per month with a transformer rating not exceeding the amount given in each case: 5 kva., $2.22; 7.5 kva., $3.33; 10 kva., $4.44; 15 kva., $5.55; 25 kva., $8.88.

(b) Six cents per kilowatt-hour as registered by the meter, less 10 per cent for payments by the tenth of the month following that for which billed.

In case energy is taken through the same meter for general purposes and electric cooking ranges, the fixed charge remains the same, the first 100 hours' use per month of the connected lights will be charged at 6 cents per kilowatt-hour and all energy used in excess of the above charge at 3 cents per kilowatt-hour, or at the discretion of the power company a separate meter may be installed and all energy used for cooking charged at 3 cents per kilowatt-hour.

These rates are based upon electricity generated by water power. In case of a water shortage a reasonable increase may be added for energy generated by steam. In case two or more consumers are served from the same transformer, the installed transformer capacity for each consumer shall be estimated and the fixed charge as given under (a) above shall be so apportioned when the bill is rendered.

The problem of inductive interference with telephone lines paralleling the farmer lines on the same highway is one that has to be met in nearly every instance. In many cases it is necessary to provide complete metallic circuits before they will give satisfaction.

Considerations Necessary in Circuit Layout and Street Lighting

IT IS generally recognized that the development of distribution engineering has not kept pace with station equipment. More expert analysis of load conditions and construction of lines is needed. Street lighting, too, appears to be on the verge of general rehabilitation and improvement.

Distribution Systems Need More Expert Attention

Mechanical Strength of Ordinary Wood Cross-Arms Is Inadequate for Heavily Loaded Systems Requiring Minimum Copper

BY S. B. HOOD
Superintendent Distribution, Northern States Power Company

IN SPITE of the fact that "a chain is no stronger than its weakest link," the distribution system in the average electric utility property receives less real study than any other part. Generating and transforming equipment has undergone most radical improvement during recent years and its installation receives very intensive study and forethought. However, when it comes to the distribution system, representing a very considerable proportion of the total system investment, its design and construction are far too often left in the hands of men who, though they may be well qualified to do the actual work, are very seldom of the type who can give proper consideration to the importance of the engineering and economic features.

Many electric light and power systems are following the lead of the telephone companies, which have been able to adopt a standardized construction specification that insures maximum service with minimum upkeep cost. In so far as it is applicable this is an excellent plan as every detail has had far more extensive study than any purely local power system could afford to give. There are, however, many very definite limitations as to the extent to which signal-line construction practice can be safely or economically applied to power-line distribution standards.

The advisability of proper preservative butt treatment as a means of lengthing the life of wood poles is beyond dispute. A properly treated pole will give at least double the life of one untreated. As the cost of treatment is comparatively small compared with the cost of the pole and the labor of setting, it follows that the depreciation item of the annual fixed charge is nearly halved.

When the life of the pole is doubled the life of everything attached to it likewise should be increased in order to maintain the economic balance. To this end all hardware must be hot-galvanized or otherwise protected against erosion. Properly protected, there is no reason why this hardware should not outlast several poles and therefore become almost a permanent asset.

Wood has proved the best material to use for cross-arms owing to its insulating qualities. However, the so-called "standard" arm and its method of installation, except on very light lines, is from the mechanical standpoint little short of an engineering farce. Given a timber with 3½-in. x 4½-in. (8.9-cm. x 11.4-cm.) cross-section and barely enough strength as a cantilever beam to support a reasonable number of conductors, the first step is to bore it full of pinholes, cutting down its area by over 40 per cent. In these holes are put wooden pins that persistently break at the very time they should not. Not infrequently one broken pin starts trouble that costs as much to put right as the cost of all the pins on the system. As a last step in this folly attempts are made to keep the arm in a horizontal position on the pole by means of a pair of flat braces, and these are expected to add to the bearing power of the arm. If a bridge designer used flat members under compression, his first bridge would land at the river bottom, and he probably in an even less desirable place. This mechanical basic principle has been violated from the day the first lines were built. Some of us have had the doubtful pleasure of seeing our cross-arms all gracefully drooping down like garden flowers after the first frost. After the sleet has melted or dropped off we serenely go out with our crews and replace them in the same way and wait to see what the next storm brings us.

BRACING CROSS-ARMS FOR HEAVY LOADS

On arms no longer than four-pin and carrying not more than the equivalent of four No. 1/0 conductors the old-style flat brace is probably strong enough to give ample safety factor. On trunk leads using six-pin arms and heavy feeder wires flat braces should be absolutely discarded in favor of angle or channel-section braces. With this type of brace the fulcrum of the lever is transferred from the through-bolt to a point over the brace end, the brace acting as a strut under compression. With this type of brace the safe load that can be carried is approximately four times that of the older method of bracing, and the cost of construction is increased but a few cents per pole. By using these properly designed braces there is no necessity of using arms of larger cross-section than standard, even with heavy feeders.

In the matter of pins utilities should get away from the idea of using a type of pin that passes through the arm, even though it be of the metal shank type. By having a pin that clamps around the arm we bind the wood fibers together and absolutely prevent splitting under undue conductor stress. A further advantage is that of being able to vary the pin spacing to suit the type of construction. In this way it becomes possible to use a standard cross-section and length of arm for all voltage classifications. One company that is using this

principle stocks only three arm lengths, all of same cross-section, and uses them for all voltages from 2,300 to 110,000. The pins used on this particular system are of two sizes and of the clamp type, the smaller with 1-in. (2.5-cm.) tops being used for voltages up to 6,600 and a higher 1¾-in. (3.5-cm.) top for higher voltages up to 33,000. Above this suspension insulators are used with the strings supported from arm clamps.

For voltages below 750, taking in all secondary distribution, the cross-arm can well be abandoned entirely in favor of secondary rack construction. These racks, with their heavy porcelain spools, not only furnish a cheap, strong means of support of these heavy and more numerous conductors, but make a line of far neater appearance. This question of neatness is one that too often is neglected, and to such neglect can be directly traced many cases of insistent demand for underground construction.

EXAMPLE OF GOOD POLE-TOP DESIGN

To show a comparison of what can be accomplished in building a neat-looking lead designed along correct mechanical principles the two pole-top drawings should be carefully studied. Fig. 1 shows the common practice of "how not to do it." Actual photographs have not been given of this type as one can go out almost anywhere and see such poles on a quantity production basis. Fig. 2 shows the same number of conductors and the same apparatus as in the former. Here it will be noted that arms are scientifically braced, pins are of proper design, and the transformer is placed in a position where it is easy to get at and where it places only about one-half the strain on the pole that it does on the top arm in the other construction.

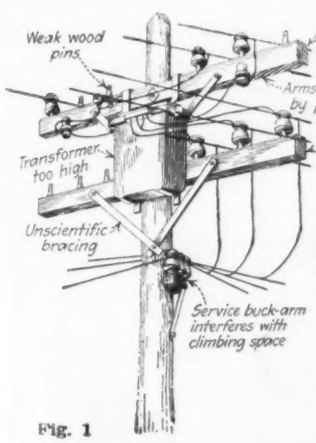


Fig. 1

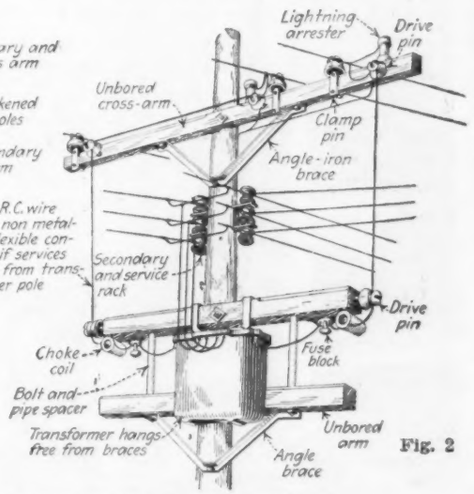


Fig. 2

FIG. 1—TYPICAL BUT FAULTY POLE-TOP CONSTRUCTION
FIG. 2—STRONGER AND NEATER THAN IN FIG. 1

Having given these mechanical problems their due consideration, equal attention should be given that of the economical balance from the electrical standpoint. The size of transformers used, their spacing and the secondary conductor size for any given load must be such that the annual fixed charges are at a minimum. The larger the transformer the lower the cost per kva. and the corresponding core loss. As an offset to this larger conductors must be used to distribute with a limiting voltage drop. There is under any condition of load and material cost some one point where the economic balance is maintained. Just where this is must be determined by accurate load survey and careful plotting. If the line foreman is capable of doing this, hold on to him—he is one in a thousand. The other 999 can waste enough money, with all the good intentions in the world, to pay for several trained distribution engineers.

In secondary distribution the interconnection of secondaries and banking of transformers offers a simple and reliable means of reducing the investment as well as adding to the reliability of service. This method of secondary operation must, however, be attempted only after most careful study and forethought. To indiscriminate banking and interconnection most of the failures in secondary network operation can directly be traced. With careful forethought and the addition of inexpensive fusible sectionalizing devices, the secondary network becomes as reliable as the old direct-current systems on which interruptions are almost unknown.

Two-wire secondary bus lines should never be used except for small scattered loads fed by individual transformer units. A good rule to apply here is to change to three-wire whenever the load is such that two No. 6 wires will not carry it without excessive drop in lamp voltage. Do not overlook the fact that the three-wire system will carry four times the load for the same loss as the two-wire system, and that it requires only one extra wire of relatively small cross-section.

In selecting wire sizes it is uneconomical and foolish to attempt to stock every size on the table. All practicable demands can be supplied by using numbers 8, 6, 4, 2, 1/0 and 4/0. The intermediate sizes are so little different that it is splitting hairs to attempt to figure drops so closely that they must be used.

In laying out the secondary network good practice does not require the neutral to be so large as the outer wires. For mechanical reasons no wire smaller than No. 6 should be used except for service drops. For larger-size secondary outers the next smaller stock size as given above will be ample for the neutral.

If the neutral of a secondary system is not properly grounded, it may be the indirect cause of serious consequences. For real protection ground to water pipes. Driven pipe grounds are a delusion and a snare. One water-pipe ground is worth a score of driven ones. Where physically possible extend neutrals so that they can be interconnected to form a grid network over the entire distribution system. This is not a difficult matter in the average city or town where normally the various secondary bus lines come close together. If the method of wiring used in any town is that of having the service enter through conduit, which should be insisted upon in order to minimize the chances of theft of energy, this conduit must be grounded to comply with the code. If multiple grounds are applied to the neutral, it should be noted that the code now permits making grounds at each individual service provided the local inspector is broad enough to see outside the four corners of the rule book. The last code edition also permits grounding to water pipes without the necessity of running to the street side of the water meter or stop cock. Under this ruling the cost of grounding is but a few cents.

Effective Street Lighting as Exemplified by the Milwaukee Installation

Center—White concrete post with prismatic glass globe supported at a height of approximately 14 ft. above the street.

Bottom—Ornamental lighting with 22½-ft. mounting height. One 6,000-lumen lamp per post. Posts 180 ft. apart. Intensity of illumination nine times full-moon light. Note the excellent detail (automobiles, etc.) even at a distance of 400 ft.

Top — Ornamental lighting with 30-ft. mounting height. Two 6,000-lumen lamps per post. Posts 180 ft. apart. Intensity of illumination sixteen times full-moon light. Note detail with which street surface and objects can be seen even at a distance.

Left—Day appearance of 30-ft. ornamental post. Note the open and spacious appearance of the street.

Right—Day appearance of 22½-ft. posts.

Important features of the Milwaukee street lighting installation are the generous mounting height, which minimizes glare, and the use of high-efficiency prismatic-glass inclosing globes. These result in a high intensity of illumination at the street level, and at the same time do not interfere with the normal functioning of the eye. Where serious glare exists even a high intensity of illumination is of no avail since the contraction of the pupils of the eye results in poor vision.

The Trend of Practice in Ornamental Street Lighting

The Choice Between Concrete and Metal Posts and Prismatic and Opal Globes Is Discussed—Period of Extensive Street Lighting Activity Is at Hand

BY ARTHUR J. SWEET
Consulting Engineer, Milwaukee, Wis.

DURING the war high prices of labor and material and the necessity of devoting all available capital to war needs led to the very general postponement of needed improvement in street-lighting service. In the summer and fall of 1920, however, there was a marked revival of interest in better street lighting, and many municipalities made tentative plans for providing improved service in 1921. General business conditions during the first quarter of 1921, on the other hand, had a psychological reaction on street-lighting projects; and there has been a tendency to await further development in business conditions before proceeding with actual installation. More recently the writer has noted, at least in the Middle West, a growing realization that material costs have reached substantially as low levels as can be expected for some time, and that labor costs, if not yet at anticipated levels, have at least dropped materially from their recent high levels. This realization, coupled with a real need for improved street-lighting service, bids fair to offset to a considerable degree such timidity as exists with respect to making increased public expenditures at this time. A rather considerable activity in the street-lighting field may therefore fairly be expected for 1921 and a still greater activity for 1922. This will be more especially true of ornamental street lighting, since great improvement in non-ornamental street lighting was made just previous to America's participation in the war. Non-ornamental installations are therefore not in such great need of rehabilitation and improvement as are the ornamental.

Facing, as we doubtless do, a period of more than usual activity in the ornamental-street-lighting field, it is especially appropriate that the electrical industry should carefully consider the trend of development in order that the public may be wisely advised and the social need be the more intelligently served.

At the present time it is worth while to give particular consideration to the suitability of concrete posts for this service and the question of using the more efficient prismatic glass for inclosing globes. There are still great differences of practice concerning mounting heights, spacing of units and illumination intensities. Several types of control equipment in common use require further analysis, and more complete knowledge of losses in the armor of steel-taped cables should be available when this type of construction is considered.

During the first decade of ornamental street lighting metal posts—cast iron, iron pipe with cast-iron fittings or fabricated sheet steel—were almost exclusively employed. About six years ago an organized effort was first made to develop the concrete post and place it in this field. During these six years the use of concrete ornamental standards has steadily grown, especially in Middle West territory. Experience with the concrete post has generally been highly satisfactory, though there have been a very limited number of cases, two or three at most, of unsatisfactory service. These are directly traceable to improper methods of manufacture or to rail shipment of the posts before the concrete was sufficiently seasoned. While the metal post is still obtaining the lion's share of new business, there are indications that the concrete post is going to constitute a greater portion of the business than it does now.

The once popular "cluster" type of post head has been found to involve such extravagant operation costs that it is no longer installed except in small towns out of touch with the best standards of practice. The trend of practice is strongly toward the use of a single lamp per post, though in the case of high mounting heights, as at Milwaukee and San Francisco, two or three lamps per post have been used to a limited extent. The opal globe continues a favorite, though the prismatic globe is coming into increasing use. The prismatic globe is characterized by approximately 50 per cent higher efficiency than the opal globe and by a considerably better distribution of light on the street, while popular taste generally prefers the appearance of the opal globe. Where some educational effort has been provided, teaching the public to make judgment on the basis of general lighting effect rather than on the appearance of an individual unit, the prismatic globe has fully met the test of giving complete and permanent public satisfaction.

A new type of prismatic globe, shown mounted on the post in the center view of the accompanying photographs, is being installed at St. Louis, about 3,000 of these new globes being employed.

TENDENCY TOWARD GREATER MOUNTING HEIGHTS

There is a definite but very slow movement toward the employment of greater mounting heights. In early ornamental installations the lamps were supported at a height of seldom more than 10 ft. (3 m.) above the street surface. From 1912 to 1914 it was common practice to make this height in the neighborhood of 12 ft. (3.7 m.). Typical present practice is to employ mounting heights of from 12 ft. to 14 ft. (3.7 m. to 4.3 m.), though in several of the larger cities materially greater heights, 25 ft. to 35 ft. (7.6 m. to 10.7 m.), have been extensively employed. The situation may be summarized as one in which engineering and service considerations constantly tend to bring about greater mounting heights, while commercial considerations—cost of changing patterns and difficulty of making metal posts in the greater mounting heights—and the tendency toward copying past practice exert a powerful retarding influence.

It is still a moot question whether the most satisfactory ornamental effect is produced by a considerable mounting height (say 25 ft.) or by a lesser mounting height (say 12 ft.). The building fronts and the street itself are unquestionably more attractively lighted in the case of the greater mounting height, and there is a very much less glare. It should also be noted that the use of greater mounting heights permits the correspondingly wider spacing of posts with equally satisfactory lighting results; and where there is an absence of all poles except the ornamentalal light posts, the open, spacious effect produced by this wider spacing of posts is most pleasing. On the other hand, the ornamental or spectacular effect of the lighting unit itself is much less marked in the cast of greater mounting heights.

Spacing.—While there are wide variations in the matter of spacing as between different installations, an average value for opal-globe installations is approximately seven times the mounting height, at which spacing the uniformity (ratio of maximum illumination to minimum) is approximately ten to one. Prismatic globe

ornamental installations have generally been planned with more careful regard to the matter of uniformity, a spacing of eight times the mounting height and a uniformity of four to one being typical of such practice.

ILLUMINATION INTENSITIES FOR CITIES OF DIFFERENT SIZE

Illumination intensities vary widely as between different installations, though limits of from five times full-moon light to twenty-five times full-moon light would include most practice in main-business-street lighting. It is the writer's opinion that an intensity of twenty times full-moon light (approximately 0.5 foot-candles) is approximately correct for the main business district in cities exceeding 100,000 population, ten to twelve times full-moon light for cities of 20,000 to 100,000, and four to eight times full-moon light for cities of less than 20,000.

Arrangement of Light Units.—While a staggered arrangement of light units will produce lighting results equally good at materially lower costs, the more pleasing appearance of placing the units in pairs opposite each other has led to the more general adoption of this arrangement. On main business streets the improved appearance doubtless justifies the increased cost, but it is doubtful if this holds true for any but the chief traffic and promenade streets.

There is still a considerable tendency toward locating ornamental posts at street corners. More and more, however, it is being realized that the ornamental unit at the corner itself generally constitutes an undesirable obstruction to traffic, and that equally satisfactory lighting and esthetic effects can be obtained by keeping all units back of the property lines of the intersecting street.

Underground Circuit Construction.—Eight years ago the proposition of laying steel-taped cable in city streets without duct protection was regarded as a radical one. Experience during the intervening period has emphatically demonstrated that the steel tape, if properly protected from deterioration by electrolysis or chemical action, affords ample mechanical protection to the cable. In the light of this experience there is an increasing tendency toward the use of steel-taped cable. Leading engineers in the street-lighting field are, however, beginning to look askance on the use of steel-taped cable from quite another standpoint—that of induction losses in the steel tape layer. Experience indicates that these induction losses are in some cases serious enough to represent a cost greater than the fixed charges on the increase in installation cost involved in a well-laid fiber-duct installation. Present practice is tending toward an increased use of steel-taped cable. It is the opinion of the writer that a fuller knowledge of the induction loss may reverse this tendency.

Three types of current control are at present in general use, as follows:

(a) Moving-coil, constant-current regulator with film cut-out at socket.

(b) Moving-coil, constant-current regulator with two-coil transformer or with compensator at base of post.

(c) Multiple-tap, constant-potential transformer with reactance transformer at base of post.

While the trend of practice is not sufficiently marked to permit of drawing conclusions based thereon, it is the belief of the writer that practice will more and more tend toward the use of the moving-coil, constant-current regulator with film cut-out socket. This system is characterized by excellent regulation, low installation costs and, most important of all, unequaled reliability and simplicity. Its chief disadvantage is that high voltage is carried to the lamp terminals, but the possible danger therein involved can be essentially removed by proper design of post and post head. Where a few lamps of higher amperage are burned on a circuit chiefly operating 6.6-amp. lamps, the above system can still be advantageously employed, using compensators with the higher current lamps. Where, however, the circuit chiefly operates lamps of higher amperage, the use of multiple-tap, constant-potential transformer with reactance transformer at each lamp has much to commend it.

Tracing the Unaccounted For Losses in Distribution Systems

In Twenty Small Systems in Kentucky Elimination of Stray Losses Produced a Saving of Energy Worth $20,000 in One Year

BY G. T. BOGARD

Chief Engineer Kentucky Utilities Company, Louisville, Ky.

THE unaccounted-for kilowatt-hours, or losses, on small and medium-size distribution systems in many cases are likely to receive less attention than is accorded to them on the larger systems. Often the energy delivered to the system is not metered, and sometimes the energy sold is not metered, as in the case of municipal street lighting, sign and display lighting, and power and light for other departments of the utility company. The small system as a rule has a higher generating cost, and the loss in money, therefore, will be proportionately higher than in large systems and certainly should not be neglected.

One company, operating a number of small and medium-size plants supplying service to a number of towns having populations varying from 300 to 10,000, recently found it necessary to effect substantial savings on account of high fuel and labor costs. In addition to the necessity of making income meet expense, it was found that station equipment was in many cases becoming overloaded, with poor prospect of securing any additional equipment to take care of the increasing demands. After making a preliminary investigation of the situation it was decided that the most economical way to solve the problem would be to utilize some of the energy lost in the delivery system.

SUBSTANTIAL SAVINGS EFFECTED BY HUNTING DOWN LOSSES

Twenty systems were selected, and the figures given in the table were made up for 1919, as a basis for effecting the saving for 1920. The net results of the undertaking may be summed up as follows: In 1920 55,872,098 kw.-hr. was distributed with a loss of 8,386,323 kw.-hr., or 15 per cent. In 1919 44,989,276 kw.-hr. was distributed with a loss of 8,093,996 kw.-hr., or 18 per cent. Comparing 1920 with 1919, the difference in percentage loss of 15 and 18 gives a 3 per cent reduction on the total energy distributed, which is 1,676,163 kw.-hr. Assuming the cost to be $0.0125 per kilowatt-hour, the same as 1919, makes the saving due to reduction in losses $20,952.

Referring to the table, it will be seen that there is a large variation in production cost and in percentage loss. In general where the greatest losses occur the cost of

energy is highest. Systems No. 2 and No. 6 show a high loss and a production cost more than five times that of No. 11 and No. 20. The effected saving in kilowatt-hours on either of the first would be worth more in money than five times the number of kilowatt-hours on the others.

In making comparisons conditions had to be taken into consideration, for in some instances all energy was measured at transformed voltages and in small quantities and in other cases large amounts were measured at

LOSSES IN TWENTY DISTRIBUTION SYSTEMS IN KENTUCKY IN 1919

Town No.	Station Production Cost (Total)	Cost Per Kw.-hr. (Cents)	Energy Distributed (Kw.-hr.)	Energy Accounted For (Kw.-hr.)	Loss (Kw.-hr.)	Loss	Per Cent Loss
1	$16,617.40	2.4	703,941	538,110	165,831	$3,979.00	23
2	17,292.69	4.0	424,796	290,971	133,925	5,357.00	31
3	14,771.83	3.0	465,440	371,881	93,559	2,806.00	20
4	13,368.25	1.3	1,011,501	862,949	148,552	1,931.00	14.5
5	28,856.08	2.8	1,001,945	819,420	182,525	5,710.70	18
6	16,723.46	4.6	354,705	273,119	81,586	3,571.00	23
7	27,165.13	1.7	1,586,016	1,328,267	257,749	3,381.00	16
8	14,645.15	1.2	1,278,872	1,070,431	208,441	2,501.00	16
9	10,938.17	1.4	789,250	674,556	114,694	1,605.00	14.5
10	17,846.12	3.5	501,317	380,335	120,982	4,234.00	24
11	35,555.98	.8	4,818,893	3,826,726	992,167	7,937.00	20
12	14,854.41	1.5	971,181	768,193	2,029,888	4,044.00	21
13	69,518.71	1.17	5,940,619	4,767,534	1,176,085	13,760.00	20
14	14,531.31	2.8	513,000	411,864	101,136	2,831.00	20
15	12,685.78	3.9	327,186	250,576	76,610	2,987.00	23
16	8,437.76	3.5	241,922	186,072	55,850	1,954.00	23
17	20,284.58	3.3	609,430	515,492	93,938	3,100.00	15.5
18	10,930.66	3.3	300,347	248,040	52,307	1,726.00	17.5
19	20,152.07	2.6	761,915	660,854	101,061	3,627.00	13.4
20	147,583.31	.65	22,387,000	18,652,990	3,734,010	24,271.00	16.8
Total	$532,759.01		44,989,276	36,895,280	8,093,996	$101,492.00	18

generated voltage. As an example system No. 17 measured and sold more than 50 per cent of the total at generated voltage on switchboard, and the losses in this case accordingly should be 31 per cent instead of 15 per cent. Additional figures were prepared showing the losses and overload in detail on each circuit in each system. By the aid of these figures more effective work could be done.

The total loss of $101,492, representing an average of 18 per cent, indicated need of immediate action. These figures and others were given each district manager with a request that a survey be made for determining the saving that could be made with reasonable expense.

CHIEF SOURCES OF LOSSES

All of these plants were built, owned and operated independently until purchased by the present syndicate from four to eight years ago. Consequently no standard method of construction could be expected. In making the survey in many cases the lines were found to be overloaded, secondaries in particular, and transformers improperly located as to load center and capacity. In some cases the cost of relocating transformers was covered by the value of transformers removed and used elsewhere. A number of old dry-type 1,100-volt transformers were being used, two in series, on 2,200-volt circuits. These had a very high core loss. One side of the secondary of all transformers has been permanently grounded, and in some cases a high resistance ground has been found on opposite side of secondary circuit. Where the ground was on the consumer's premises, and unless the current coil of meter was connected in a non-grounded side of circuit, the loss would not be registered by the meter. Many meters were found to be slow, a few fast, and a considerable number improperly connected.

After making a survey of the situation and analyzing the results, work was started to bring about a reduction in losses. In order to keep the men posted as to the result obtained, monthly reports were made up showing the losses on all circuits, and the position of each was shown in the order of percentage loss. In a very short time the losses were on a decline, and at the end of the year 1920 the reports showed that a marked saving was made.

One distribution system, supplying a town of 5,000 population, received special attention with a view of determining how near the actual losses could be brought to the calculated losses. By calculated losses it is meant that core losses of transformers were measured, the size and length of copper wire in loaded circuits were measured and losses calculated, and also losses in meters and copper losses in transformers were estimated. After the distribution system was put in good condition and all meters calibrated the actual loss over a four-month period checked within 5 per cent of the calculated loss.

Minimizing Capital Investment in Line Construction

By Simplifying Overhead Construction Profitable Load Was Developed in Sparsely Settled Cape Cod District—Joint Poles with Telephone Company

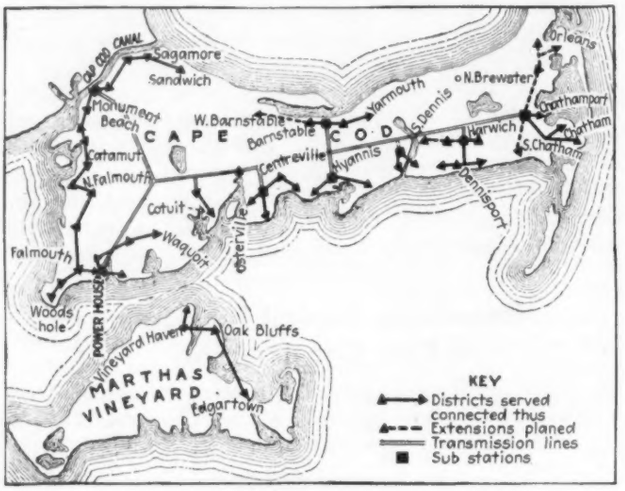
BY EUGENE CARPENTER
Treasurer Cape & Vineyard Electric Company, Falmouth, Mass.

IN PROVIDING facilities to give electric service profitably and economically in the sparsely settled Cape Cod district of Massachusetts some methods have been employed which may be of service elsewhere. The development on the cape began at Falmouth and has steadily extended until today about 65 miles (105 km.) of transmission line are in operation and more than 5,000 customers are served. From the first it was recognized that owing to the large area which must be covered and the low density of population in that area methods which were generally in use would not be suitable if the project were to succeed. At first 6,600-volt lines were used, the typical circuit consisting of three No. 6 bare copper conductors with 7,000-volt insulators mounted on wooden poles. The cost was in some cases only $900 per mile. The territory was favorably located with regard to tidewater, pole deliveries as a rule being made from Long Island from points not easily accessible to railroads but convenient for transportation by small sailing vessels.

At the outset it was seen that pole distances would have to be stretched to the safe limit, or else the investment costs would make it impossible to develop a large part of the territory. Considerable data were available from the experience of local telephone and telegraph interests extending over a score of years, and it was well known which direction of the wind gave the most destructive results. Thus, a northeast or a southwest wind was always very destructive to a line crossed by the air currents at approximately a right angle, whereas a line of inferior construction was seldom injured by a wind blowing parallel to the line direction. This led to the use of spans of varying length, owing to the relation of the local section of line to wind prevalence and force.

At first the telephone organization in the territory preferred to make no joint distribution pole-line contracts with the central-station organization, which was weak and struggling; but by persistent application to

this problem a contract was finally agreed upon which has been mutually beneficial. Line construction plans were carefully made and revised again and again before being put into operation. The idea back of the whole enterprise was that investment costs must be reduced to their lowest terms in order to insure even a moderate success. The lines were calculated with great care, and data which had been worked out by the Roeblings in



SPARSELY SETTLED CAPE COD DISTRICT SUCCESSFULLY SERVED BY THE CAPE & VINEYARD ELECTRIC COMPANY

suspension-bridge construction were available and were used in determining the distances apart for poles. Semi-hard-drawn copper was used in quantity, as this had the same conductivity as commercial wire and a tensile strength of about 50,000 lb. per square inch (3,500 kg. per sq.cm.). On lines of small carrying capacity iron wire was used, generally galvanized No. 6, E. B. B. Combined with the use of the tungsten lamp it is surprising how small an investment is required to secure a fairly good amount of lighting business.

Spans were initiated at about 200 ft. (60 m.). then these were extended to 250 ft. and even to 375 ft. (75 m. to 115 m.). In operation lines of this type have given no trouble, and in some cases 500-ft. (150-m.) spans have been employed. These last, however, have been used only with No. 4 galvanized-steel wire or larger. Considerable care must be taken in the use of such long spans, and today spans would not be built, as a rule, in excess of 250 ft.

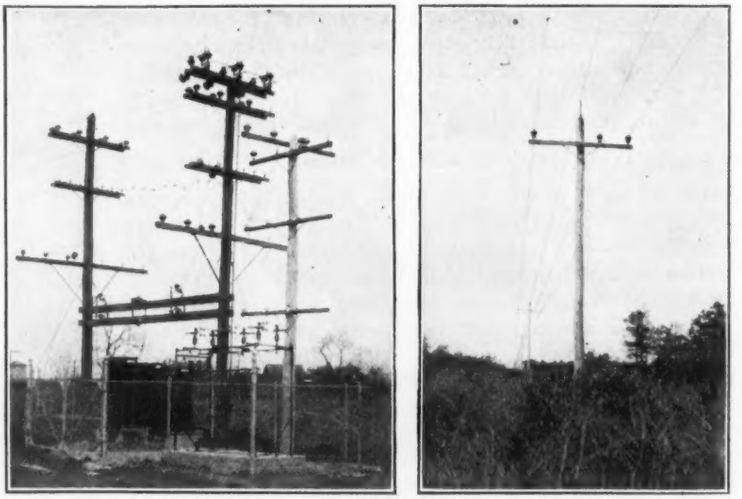
It is evident that with these long spans greater separation must be made between the wires than is usually done, and the engineering rules which have been thought so necessary in regard to inductance and capacity, and which in lines of large current capacity are important, have been found relatively unimportant in operating these short lines.

Today the load requirements call for the use of a four-wire Y-connected transmission, with a voltage of about 22,000 between phase wires and a neutral carried at the pole top about 24 in. (60 cm.) above the other three conductors. The neutral is grounded, and the potential between any conductor and ground is about 13,200 volts. Using three No. 6 copper and a ⅜-in. (9.5-mm.) Siemens-Martin steel neutral ground wire, the present high-voltage line cost, including a right-of-way, is about $1,480 per mile. Only slight additions have been made to these lines since the period of increased material cost began, with the exception of that required during the war. Probably these cost figures could not be duplicated at present, but fortunately the company has its transmission system virtually complete except for minor extensions.

The rights-of-way permit of ample tree trimming. The largest step-down transformer is rated at 200 kw. and the smallest at 5 kw. Aluminum-cell lightning arresters have been installed at points near which a troubleman is located, so that charging can be handled satisfactorily, and at more remote points oxide-film arresters are used with good satisfaction. No large motor load is available in this territory, although at Sandwich a refrigerating plant is in service with a total installation of 112 hp.; 35 hp. is installed in a brickyard at Barnstable, and at Chathamport there is a 45-kw. synchronous motor-generator for charging batteries in the high-powered receiving station of the Radio Corporation of America. An engine-driven steam plant is located at Falmouth, but at present energy is purchased from a system interconnected with the large steam station of the New Bedford Gas & Edison Light Company. It is planned later to install mixed-pressure turbines in the Falmouth station. The minimum load of the Cape Cod system is now 36 per cent of the maximum.

The small energy requirements of the tungsten lamp have been a vital factor in the development of the system, coupled with rates specially designed to overcome as far as possible the handicap of being obliged to serve the peak business of the year in the four summer months. For every dollar of sales in the smallest months the company takes in $19.20 in the largest month.

Of vital importance has been the planning of transformer locations and cutting out those not in use, to keep line losses at a minimum. This company feels that the abandonment of the 600-watt size and the proposed doing away with the 1-kw. size by manufacturers is a great hardship to companies serving territories like the Cape Cod district. A 750-watt, 2,300-volt primary transformer is needed, and it is hoped that companies situated like this one will protest vehemently to the end that such a unit may be obtainable.



SIMPLE SUBSTATION AND LINE CONSTRUCTION FOR SERVING SCATTERED LOAD

Meter Reading and Collections

IN THE smaller communities where the number of customers is not large it takes an uncommon amount of tact to keep the customer happy when paying his bill and still not have an expensive accounting system.

Direct Billing by Meter Readers Cuts Cost

Reduction in Time Between Reading of Meters and Payment of Bills Effects a Saving of 4½ Cents per Month per Consumer

BY J. R. KAISERMAN
Manager Livingston Branch Montana Power Company

NEARLY three years' experience by the Livingston branch of the Montana Power Company with direct billing of consumers by meter readers has demonstrated that the method employed has many advantages and shows a considerable saving over the one formerly used.

Under the old method of billing the meters were read by the meter reader and the readings entered and figured in the consumers' ledger. From this the bills were prepared, put in envelopes, stamped and mailed. Unless a window envelope was used it was further necessary to address the envelope. Several days after the meters had been read the bills were delivered by the postman, who covered virtually the same ground as had the meter reader. As the entire procedure was wasteful an effort was made to eliminate all unnecessary duplication.

The first thing was to eliminate the meter readers' record book. It was found that the addressing-machine plate could easily supply the necessary information such as the company's serial number for the meter to be read. This number is either on an aluminum tag attached to the meter, under one of the binding nuts on the face, or is placed on the meter by a rubber stamp which imprints the number on the dial plate. Following this number a letter, or combination of letters, is the key denoting the meter location, and following this is a numeral signifying the classification of the consumer. This latter classification number denotes the kind of service which the meter records. The meter readers' routes are laid out to make the walks as short as possible, so that no unnecessary overlapping is done, and the consumers' accounts are arranged to coincide with the route taken by the meter readers.

In the plan now in use the bills for a certain route are run through the addressing machine in the same order as found in the ledgers, and necessary information is written on the bill, such as the previous reading and date, the meter constant and readiness-to-serve charge (if any), the balances due, and, in the event of power users, the fixed charge and the corresponding rate.

The meter reader (better called the outside office man) is now ready to start on his route to read meters, compute the bill and leave it with the consumers. The bill is thus rendered several days sooner than by the old method. No attempt is made by this man to collect the amount of the bill as we wish to have our consumers come to the office, where appliances are on display.

The stubs, bearing copies of the bills left with the consumers, are then returned to the office and placed in a file near the cashier's window. When the consumer produces his bill to make payment the route and serial number are noted by the cashier and the corresponding stub is quickly located. Before closing the day's business the cash receipts are listed by the route and serial number to check against the cash, and the following day these stubs have their new data posted on the consumers' ledgers. In one operation the new reading, the date of reading, the kilowatt-hour consumption, the amount of the bill and the amount paid, as well as the discount allowed, are all posted. We find that approximately 90 per cent of the bills are paid within the five-day discount period allowed. The bills unpaid within that period are posted from the stubs left in the cashier's file.

KEY TO COMMERCIAL CLASSIFICATION

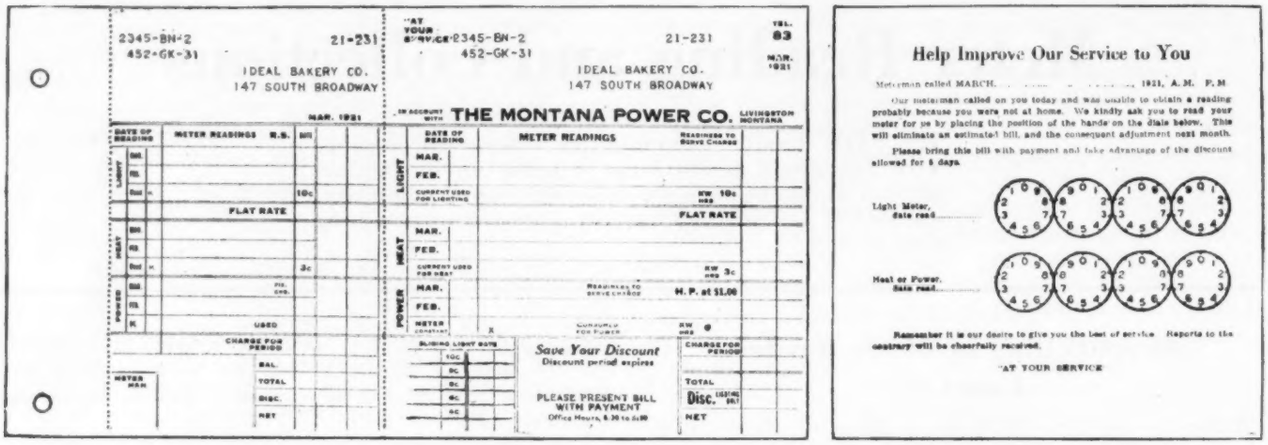
Complete classification of consumers simplifies form of billing.

No.	Lighting
1	Residences
2	Stores
3	Hotels and rooming houses
4	Offices
7	Industrial establishments
8	Miscellaneous
9	Restaurants
10	Amusement parks
11	Bowling and pool rooms
12	Churches
13	Depots
14	Hospitals
15	Laundries
16	Livery stables and garages
17	Lodge halls and clubs
18	Saloons
19	Schools
20	Signs (metered)
21	Theaters
22	.....
23	.....
24	Commercial arc lighting
25	Commercial, including flat rate and signs
26	Municipal arcs, alternating current
27	Municipal arcs, direct current
28	Municipal street lighting
29	Municipal building lighting

No.	Heating
5	Electric ranges
6	Other heating

No.	Power
30	Commercial power, flat rate
31	Bakeries
32	Brick plants
33	Breweries and malt works
34	Butcher and packing plants
35	Cement works and rock crushers
36	Creameries and refrigerators
37	Grain elevators
38	Freight and passenger elevators
39	Foundries and blacksmiths
40	Garages
41	Laundries and cleaning establishments
42	Marble works
43	Mines
44	Mine mills
45	Flour mills
46	Print shops
47	Pumping (irrigation)
48	Railroad shops
49	Schools
50	Smelters
51	Theaters
52	Woodworking
53	Industrial establishments
54	.....
55	Miscellaneous
56	Municipal power

The advantages shown after more than two years' operation of this method are these: The meter-record books are eliminated; the time necessary for transcribing the readings to the ledgers is saved; there are no bills to prepare from the ledgers and no placing of bills in envelopes, stamping and mailing; bills are in the hands of the consumers three to five days earlier than before, and accounts are collected much sooner. An advantage noted by the cashier is that it is no longer necessary to run through the ledgers to see what



LEFT—FORM OF BILL USED BY METER READERS. RIGHT—REVERSE SIDE OF BILL

The number "2345" stenciled in the upper left corner of this bill is the meter number; the letters "B N" indicate the meter location as being in a cabinet on the second floor; the figure "2" indicates service to a store; the figures "21-231" are the route and serial number. The reverse side of bill is to be filled out by consumers when access to meters is impossible.

accounts are unpaid. As long as any stubs remain in the file he knows that they represent unpaid accounts, and delinquents are easily followed up.

Another advantage is that where the meterman has no record of previous readings for several months back to indicate the usual monthly consumption of energy, he becomes more efficient in reading meters as he does not have anything to serve as a guide and has no opportunity to "guess" the reading. We now find it extremely seldom that an error is made in readings as the meter readers have been trained to become more accurate and self-reliant.

No effort is made to read meters as "follow-ups" in the residences except where there are special reasons for doing so. Many consumers to whose premises the meter readers have not been able to gain access when on their routes bring in their own readings, feeling that we have mutual confidence and that they have thus forestalled the rendering of an estimated bill. Our appreciation of their interest is always extended to them for this service.

The system outlined is applied to all consumers except in the case of a small number of very large customers, for whom a special form of bill is used. As nearly as the saving in expense over the former method can be computed, the amount is placed at approximately 4½ cents per consumer per month. No complaints on the part of the consumers have been made, and certainly the plan has minimized the work of the office force.

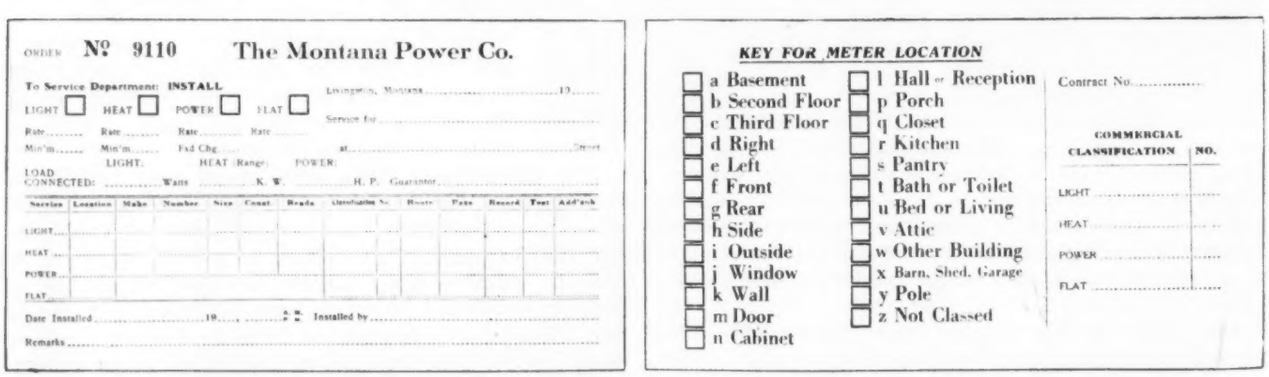
Meter Readers Can Create or Destroy Good Will

Bonus System Is Frequently the Cause of Trouble—A Method that Reduced Adjustment and Special Tests Expense and Established Good Will

BY R. S. SEESE

General Manager Smith County Electric Company, Carthage, Tenn.

THE profitable and continued operation of most public utility companies is largely if not altogether dependent upon securing and holding the confidence of the taxpayers. Since most of the taxpayers are also customers the contact which the company has with its consumers is of utmost importance. In possibly 90 per cent of the cases the contact is established and maintained through the meter readers; still, companies which have recognized the importance of friendly relations between themselves and the public have overlooked this all-important fact. This is not said to discount the value of selling company securities to customers, maintaining complaint-adjustment departments, distributing educational propaganda or providing convenient and attractive offices where consumers may pay their bills. However, many remittances are made by mail, many consumers never see the company officials, some seldom read company literature, and many do not care to purchase securities. Nevertheless, such con-



FRONT AND REVERSE SIDES OF INSTALLATION ORDER FORM WHICH FURNISHES A COMPLETE RECORD OF ACCOUNT

sumers must be established as friends, and the prevention of one error in meter reading or billing would be worth fifty corrections in bringing about this relation. Quite naturally the average consumer is prone to form his opinion of the entire company by the actions of its representatives who call at his home, namely, the meter readers. Therefore why is it not a good investment to raise the standard of this class of labor?

Friction with consumers can be traced largely to the practices of guessing at the meter reading, unauthorized entrance to premises, deliberate underreading to pacify the consumer at the time, a disposition to argue or resent, and lastly, ignorance of the company's policies and methods, together with inability or lack of inclination to explain any apparent discrepancy or extraordinary features of the consumer's bill. The consumer is ordinarily referred to the complaint department for answers to his questions, and the name itself suggests argument and ill will. Such irritation could be avoided in two minutes, usually, if the meter reader were equipped with moderate mental ability and proper instruction. Besides, he would be able to establish a feeling of confidence and good will on the part of the consumer.

Causes of Trouble

Responsibility for troubles with consumers can be attributed largely to the bonus system with its penalties for errors and omissions in meter reading. In one recent case an Eastern company was fined $500 by the courts because its "bonus" reader frightened a woman by unauthorized entrance to avoid missing a meter reading. In another case an Illinois meter reader was seriously injured in a fight because he entered a bathroom to read the meter without observing proper formalities. In these cases the meters were read by boys who earned anywhere from $2 to $3, depending on the number of meters read per day. This amount would scarcely attract men capable of properly representing a large utility company or of maintaining a courteous bearing to its consumers.

Trouble such as that alluded to is avoided by one Middle West company, which has 40,000 consumers, by paying meter readers enough to attract intelligent young men who will take an interest in their work and be uniformly courteous. Instead of placing a bonus on the number of meters read per day the territory is divided into districts, the time required to cover the territory is estimated, and the meter reader is expected to stick to the time allowed within reasonable limits. The readers are thoroughly instructed in how to meet and talk with consumers and are provided with blank forms on which any complaints which cannot be adjusted by the reader are written, signed by the consumer and forwarded to the adjustment bureau.

After two years' experience with this system, which increased the meter-reading expense about 40 per cent, the personnel of the adjustment bureau was decreased one-half, requests for special meter tests were virtually eliminated, and the general attitude of the public and the press was so modified that an application for increased rates in 1919 was granted by the State commission with almost no protest. The net increase to the company in cost of operation on account of this system amounts to only one-fourth of the normal advertising expense, and the value in friendship of the public is incalculable.

A smaller company in a Southern state provides triplicate forms for its readers, arranged according to route, on which the previous meter reading and any arrears are printed. The meter reader makes out the current bill on the ground and collects the total. This eliminates considerable office detail and makes collections simpler, but of course requires a higher grade of labor, and it is applicable only to smaller towns and to widely scattered communities and rural service.

On the average meter reading will probably cost 0.75 cent per meter read, although the expense may vary from 0.5 cent to 2 cents, depending on the density of service and the character of the district.

Mail Collection of Consumers' Bills in Scattered Territory

How a Company Educated Its Customers to Pay Their Bills by Check—Minimum of Trouble and Expense —Method Used for Three Years Without Loss

By B. W. Little

Manager Liberty Light & Power Company, Liberty, S. C.

WHERE the customers of a light and power company are in small towns and scattered rural communities collection of bills can be made at a minimum expense and trouble by utilizing the mail. Several plans were tried out by the Liberty (S. C.) Light & Power Company, which has distribution systems in three near-by towns and intervening rural territory. A local merchant was appointed in each town to act as cashier for the company, but this method was discarded because there were too many cashiers, and when an error occurred it was next to impossible to trace it. Local collectors were also tried, but they got only the convenient customers' checks or payments and left a good portion of the bills uncollected, so that some one from the main office had to go out and follow them up.

The first remedy applied was to arrange for a bank or a local representative to have all bills on file and then mail out cards to each customer giving the amount of his bill and informing him of the local representative's name. Forms for this purpose were printed on private mailing cards. This scheme worked better, but did not eliminate errors. In several instances it was found that unauthorized parties had received the money or checks, and they were often misplaced. This brought considerable trouble and resulted in the loss of several payments because there was no way to trace the misplacements.

Method Adopted

Another method of collecting local bills by mail—the one now used—then received a thorough trial in one town, and after some changes it was adopted for the entire territory served by the company.

This method involves the use of a combination form, containing the regular consumer's bill on one side and on the reverse side a blank check for the customer's use as illustrated. A distinctive color of stationary is used for each company, town or station in order to avoid confusion. The account number appears on the bill, the check and the return envelope. The check on the reverse of the bill is filled out for the amount of the bill and dated, and the return envelope inclosed is stamped.

A post office box is rented at each town so that only the minimum postage is required in case there is a one-cent drop letter rate. In case of delivery by carriers

two-cent postage must be used. On regular visits the mail is taken to the main office from the local boxes, and all clerical work is done there. By thus renting a post office box at each local station at a cost averaging $2 per year and mailing the bills in a bundle in the local offices we eliminate all unnecessary handling. The only additional expense as compared with the usual methods of mailing bills is the cost of the manila return envelope and the postage.

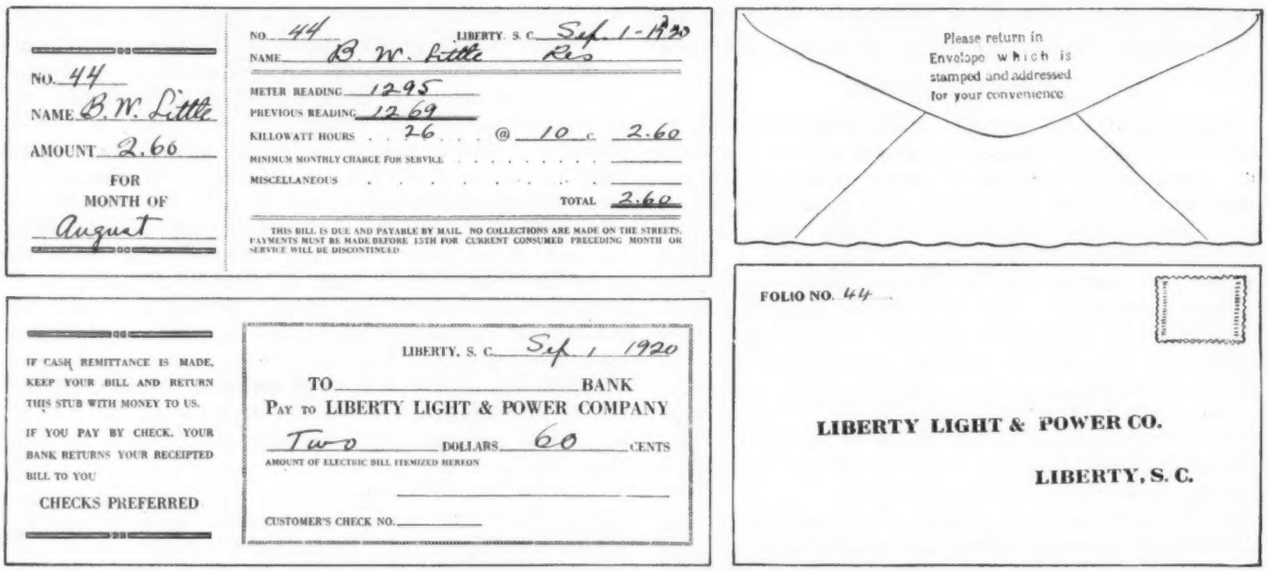
The mailing scheme was submitted to the banks and had their approval, the only change suggested being that the forms should correspond with the standard-size bank check. The general form of the bill was designed with this in view. The next step was to send out a form letter a few days previous to mailing the first bills advising customers that no collector would call and describing the method that would be employed. This letter was made as brief and plain as possible, and the bills followed while the matter was fresh in their memory. The plan was received with favor by the business men, who were not bothered by collectors or by having to go to some designated place to settle their bills.

Of course, in a few instances where the idea was not understood we had to make personal visits to make it clear so that all customers would become accustomed to mailing their remittances. Many persons not acquainted with the advantages of paying bills by check were made to see the protection it afforded and were induced to make small deposits for this specific purpose.

When a check is not received at the time it is due, a duplicate bill is sent calling attention to the oversight. This second bill does not carry with it a stamped envelope, but does carry an envelope to which the customer must add postage.

The method has the indorsement of all the banks since it encourages the making of small deposits to care for the bills and educates patrons to the advantage of paying bills by bank checks. Of course, there is a percentage of customers who will not use the check system. However, the heavy brown envelope is a stout holder for currency and small change for those who are willing to take the risk. The customer is identified by the number on the envelope even if no other means of identification is inclosed.

During the three years this system has been in use there has not been a single instance in which a cash remittance was not received just as it was mailed, and it is hard to believe that any other method of collecting scattered accounts can show such a record.


NO. 44
NAME B. W. Little
AMOUNT 2.60
FOR MONTH OF August
NO. 44 LIBERTY, S. C. Sep 1-1920
NAME B. W. Little Res
METER READING 1295
PREVIOUS READING 1269
KILOWATT HOURS 26 @ 10 c 2.60
MINIMUM MONTHLY CHARGE FOR SERVICE
MISCELLANEOUS
TOTAL 2.60
THIS BILL IS DUE AND PAYABLE BY MAIL. NO COLLECTIONS ARE MADE ON THE STREETS. PAYMENTS MUST BE MADE BEFORE 15TH FOR CURRENT CONSUMED PRECEDING MONTH OR SERVICE WILL BE DISCONTINUED
IF CASH REMITTANCE IS MADE, KEEP YOUR BILL AND RETURN THIS STUB WITH MONEY TO US.
IF YOU PAY BY CHECK, YOUR BANK RETURNS YOUR RECEIPTED BILL TO YOU
CHECKS PREFERRED
LIBERTY, S. C. Sep 1 1920
TO BANK
PAY TO LIBERTY LIGHT & POWER COMPANY
Two DOLLARS 60 CENTS
AMOUNT OF ELECTRIC BILL ITEMIZED HEREON
CUSTOMER'S CHECK NO.
Please return in Envelope which is stamped and addressed for your convenience
FOLIO NO. 44
LIBERTY LIGHT & POWER CO.
LIBERTY, S. C.

LEFT—COMBINATION CONSUMER'S BILL WITH BLANK CHECK ON REVERSE SIDE. RIGHT—RETURN ENVELOPE

The bill is made out on this form, the account number appearing on both the bill and the stub. On the reverse side the blank check is filled out for the amount of the bill.

This envelope also carries the customer's account number and is inclosed stamped with the bill for customer's use in making remittance.

Indianapolis Banker Tells of Value of Customer Ownership

"A STRIKING phase of public utility development of the last few years," said George C. Forrey of the Fletcher American National Bank, Indianapolis, recently, "lies in bringing the public and the utilities closer together through what is known as the customer-ownership movement. A large number of progressive companies have invited their customers to become profit-sharing partners in the business, offering as a rule their preferred stocks for cash investment or on a partial-payment basis. The response of the public has been surprising. Customer-ownership is proving to be of the greatest value in improving the public relations status of the service organizations. It means popular ownership with retention of the virtues of private operation and responsibility. No more satisfactory result than this can obtain under any other condition that would give proper service.

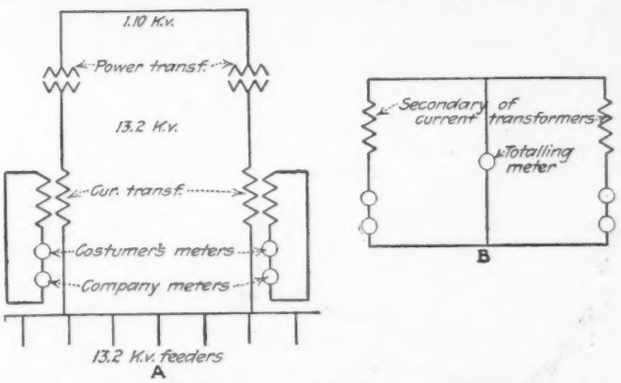
"The public attitude toward utilities is very different from that of 1914. The public has come to realize the inseparable importance to the individual and communal welfare of electric light and power and electric railway transportation. Moderate increases in service rates have been contrasted with doubled and tripled prices for other necessities. Disappointing results from government railroad operation have been compared with continued efficiency by the privately owned utilities. The result has been a much fairer public sentiment and a strengthening of the hands of state and municipal bodies in granting equitable rates to the companies."

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

One Meter Measures Total Power on Two Buses

A TOTALIZING watt-hour meter which is thought to be as simple as possible and which at the same time gives commercially accurate results with a minimum of expense has been placed in service by the Alabama Power Company. Almost every one is familiar with the problem of measuring the total station output where several polyphase generators feed into a system of buses which in turn supply various feeders. The problem has sometimes been solved by the use of a totalizing meter with several elements operating on one



ONE METER (AT B) USED TO MEASURE TOTAL KILOWATT-HOURS ON TWO 13,000-VOLT BUSES

shaft, each set of elements being energized by the current and voltage from one particular generator. But this is expensive, not only in first cost but in maintenance.

On this system a large customer is fed through two banks of 110,000/13,200-volt transformers into two buses which are normally tied together and only operated separately for a few moments at a time during periods of interruptions. There were formerly two meters on the 13,200-volt side, one for each bank of transformers. As the customer concerned was a large one, a duplicate set of meters was operated from the same current and potential transformers to check the recording of the first set.

A simpler scheme of measurement was sought. The 110,000-volt lines are tied together at a station 13 miles distant from the customers' substation, hence the load is not equally divided between the two banks. However, as the low-tension voltage of the two banks is bound to be the same and the 13,200-volt currents combine in the buses to produce the power actually delivered to the customer, it was decided that the currents in the secondaries of the 13,200-volt current transformers should also combine correctly if they had an opportunity. Accordingly the experiment was tried of connecting the secondaries of the two sets of current transformers in multiple and allowing the combined current to operate a fifth polyphase meter, which thus became a totalizing meter. The original connection of the current transformers in single-line diagram is as shown by *A* in the diagram. At *B* are shown the connections for the totalizing meter, omitting all but the secondary connections of the current transformers. It will be seen that the individual meters, as before, continued to measure the power from the individual banks, and that the totalizing meter received the sum of the two currents.

The operation of these five meters was watched very carefully, and at the end of a thirty-day period the difference between the kilowatt-hours shown by the totalizing meter and the average sum of the others was 0.26 per cent. This was so satisfactory that the four individual meters were removed and a second totalizing meter installed as a check meter for the first. The arrangement has been operating for a period of sixty days in its final form and giving perfect satisfaction.

Alabama Power Company, Birmingham, Ala. — S. A. FLETCHER, Superintendent of Service.

Resistance of Earth Between Stations

IN THE calculation of the short-circuit current in an extensive transmission network the resistance of the ground connections and of the earth between widely separated stations plays a rather important part. Inasmuch as such calculations always involve the use of many variables, some of which are indeterminable, it is best to have accurate information on as many of these variables as possible. For this reason the San Joaquin Light & Power Corporation in June, 1920, made a series of tests of the resistance of the ground connections and of the earth between several of its stations.

The measurements were made with a Wheatstone bridge. The circuit in each case consisted of one wire of the transmission line, the station grounds at the two ends and the earth between as the return conductor. The stations are situated in a level valley which has ground water at a depth of from 12 ft. to 15 ft. below the surface under the entire section involved.

At station No. 1 the ground connection was made by means of ten 20-ft. lengths of 1-in. galvanized-iron pipe driven into the earth at various points surounding the station. All of these pipes were connected to a heavy copper wire. At station No. 2 the ground connection consisted of six 20-ft. lengths of 1-in. galvanized-iron pipe driven into the ground and interconnected as at station No. 1. At station No. 3 the earth connection consisted of four 20-ft. lengths of 1-in. galvanized-iron pipe driven into the ground and connected as in station No. 1.

Between station No. 1 and station No. 2 the resistance was found to be 2.32 ohms. The distance between the stations was 9.5 miles. The earth resistance between stations No. 1 and No. 3 was found to be 3.17 ohms. The distance between these stations is 29.5 miles. These figures are for the resistance of the entire

circuit with the resistance of the one conductor of the transmission lines deducted. Therefore they show the combined resistance of the ground connections at the two stations plus the resistance of the earth between the stations.

Another test was made between stations No. 1 and No. 2 in which a well at station No. 1 was used as a ground instead of the ten ground pipes. This well is 104 ft. deep and is cased with No. 16 galvanized-iron casing, 8 in. in diameter. This test gave a resistance of 1.62 ohms as against 2.32 ohms in the other test.

Two months later the new Kerckhoff hydro-electric station of the San Joaquin Light & Power Corporation was placed in service, and an opportunity was available to make a similar test in this case before the line was energized. The ground at Kerckhoff station is made to the penstocks, which are very large and should have plenty of ground contact area. However, they rest on solid granite and the best path for ground currents is probably through the water they carry, thence to the river and down the river to the valley. The transmission line parallels one of the company's 66,000-volt lines for a short distance, and for that reason the Wheatstone bridge could not be employed for accurate measurement. Direct current at 250 volts was used in making the test, and the resistance between the Kerckhoff station and station No. 2, a distance of 28 miles, was found to be about 11 ohms. This value is the resistance of the earth between the stations plus the contact resistance at the two stations. These results were obtained, of course, at a time when the station grounds were carrying no other than the test current and would therefore be useful only in determining instantaneous short-circuit currents. No doubt they would be higher if heavy current were permitted to flow for any considerable time and thus dry out the earth around the ground pipe.

L. J. MOORE,
Electrical Engineer.
San Joaquin Light & Power Corporation,
Fresno, Cal.

Some Pointers on Keeping a Generating Station in Good Condition

SINCE uniformity of fuel-bed thickness is such an important factor in maintaining high boiler efficiency, great care must be exercised in keeping the hopper coal gates in good condition. When the gates are three or four bricks short enough coal will be wasted to pay another fireman. The coal will pass into the furnace in ridges and not have time to burn before it goes over into the ashpit. Another thing that needs very close watching is the formation of clinkers. For instance, a clinker 6 in. thick on a side wall shoves the coal away from the wall, letting cold air pass along the wall and cool it. Such a clinker also reduces the effective grate surface and forces coal to run over into the ashpit only partly burned. Another bad place for a clinker to form is on one end of the bridge wall. This will deflect the fire to one side so that the gases will not be distributed equally through the boilers. Slag on the tubes on one side of the boiler has the same effect as a bridge-wall clinker, driving the gases to one side. If draft gages are watched closely, the differential pressure will indicate when boiler tubes are becoming "slagged up." If a boiler is slagged up, take it off the line and clean it. Usually this should be done at night.

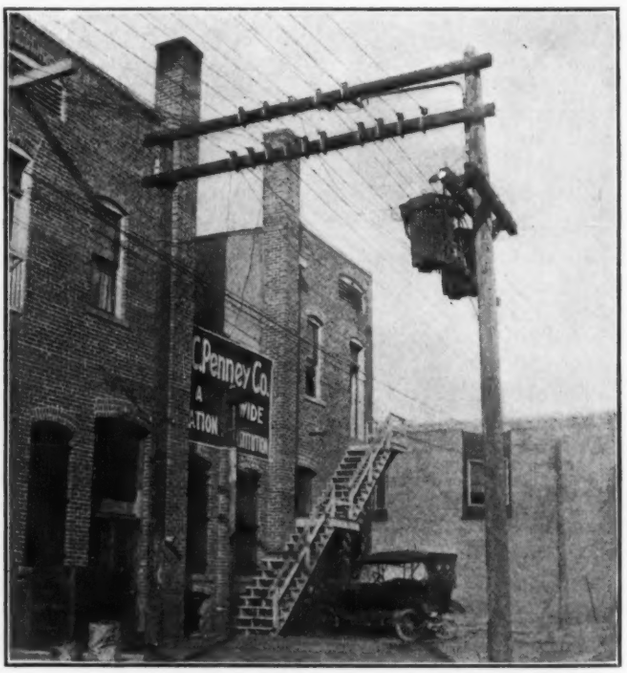
Next in importance in the boiler room comes the feed-water heater. See that it is kept clean, that the pans are in their proper place and that the relief valve is working properly. Inspect the valve of the live-steam trap for leakage. A by-pass is to be put on all the traps of this company so that by opening an open-end valve in the trap it may be ascertained at a moment's notice whether the trap is leaking or not.

In the engine room the vacuum should be checked frequently. If it has gradually been decreasing on peak loads but has been good on half load, the trouble probably is a dirty condenser or intake screen. The circulating pump may be worn or some obstruction may be lodged in the runner of the pump. If, however, the vacuum is poor at all times with light or heavy load, look for leaks. The most probable place to find an air leak is in expansion joints, stuffing boxes or valves, vacuum-pump valves or hot-well gland seal.

Iowa Railway & Light Co., JOHN W. MAY,
Marshalltown, Iowa. Traveling Engineer.

Substantial Alley Construction for Heavy Leads

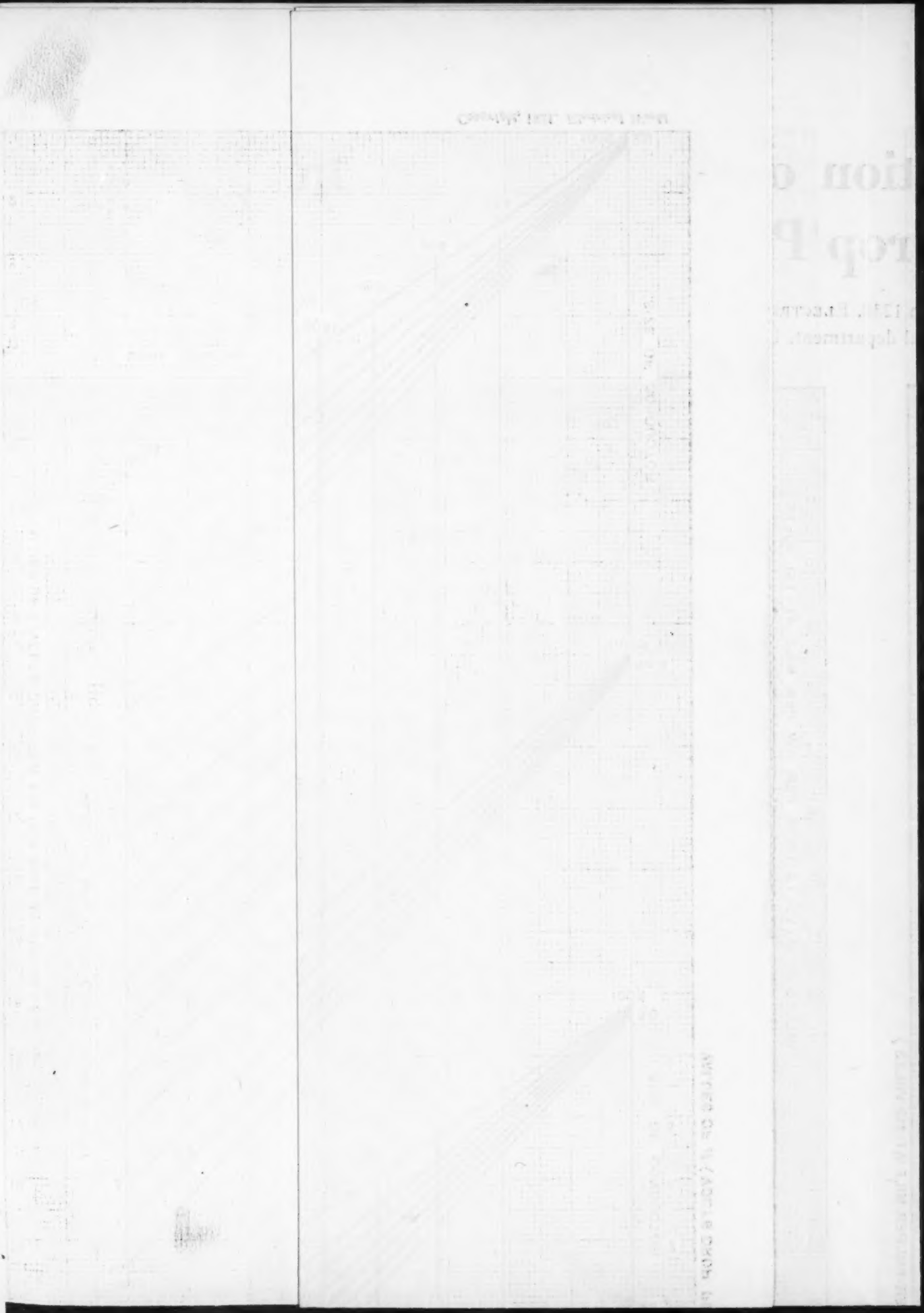
AVOIDANCE of the usual unsightly alley construction, where all the lines are on one side of the poles, has been effected by the Albuquerque (N. M.) Gas & Electric Company. As shown in the photograph, rather light poles have been set on both sides of the alleys in the business district and long cross-arms placed between them. The number of arms depends upon the



SERVICES MAY BE EASILY TAKEN OFF TO EITHER SIDE OF THIS ALLEY CONSTRUCTION

number of circuits. The usual width of the alleys is about 18 ft. Transformers are hung on one or the other of the poles in the usual manner and are connected to the lines by wires run along the arms in conduit. The cost of this construction is considerably less than that of underground construction, which would not be warranted in a city the size of Albuquerque.

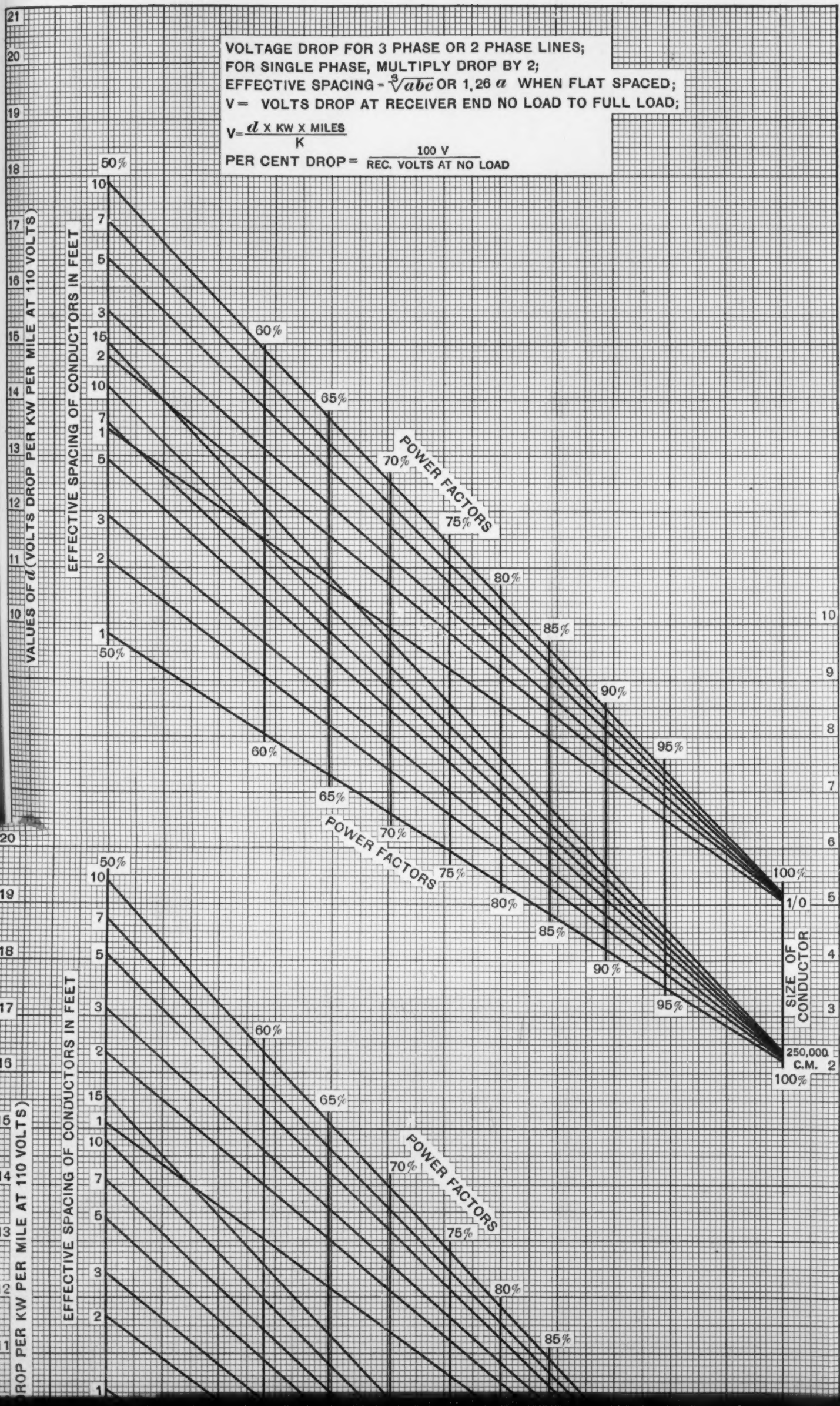
FIELD EDITOR ELECTRICAL WORLD.
San Francisco, Cal.



Charts for Quick Solut
of Line Dr

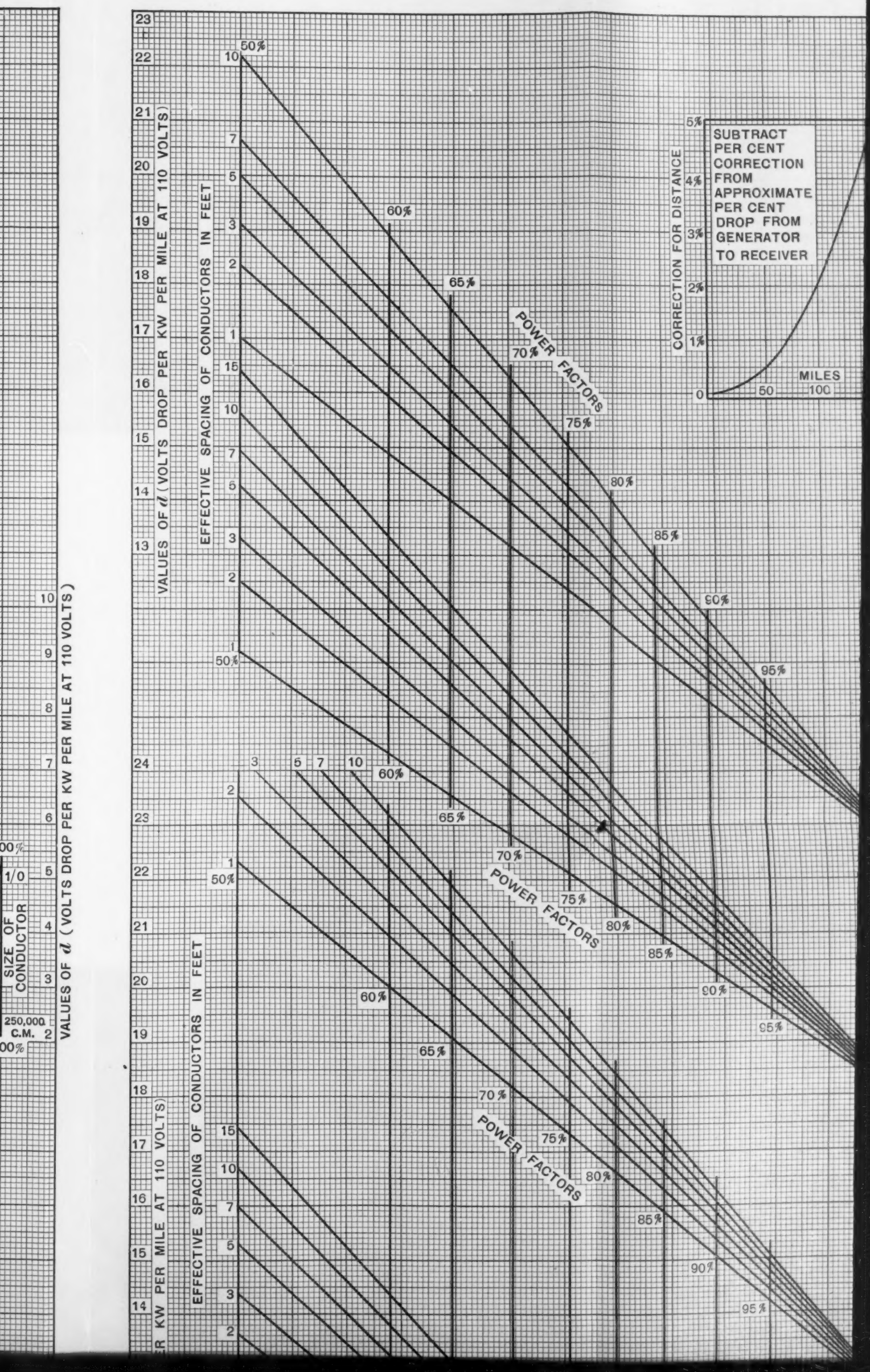
Supplement to Article on Page

By E. P. Peck, general superintendent electrical


VOLTAGE DROP FOR 3 PHASE OR 2 PHASE LINES;
FOR SINGLE PHASE, MULTIPLY DROP BY 2;
EFFECTIVE SPACING = $\sqrt[3]{abc}$ OR 1.26 a WHEN FLAT SPACED;
V = VOLTS DROP AT RECEIVER END NO LOAD TO FULL LOAD;
$V = \frac{d \times KW \times MILES}{K}$
PER CENT DROP = $\frac{100\ V}{REC.\ VOLTS\ AT\ NO\ LOAD}$
VALUES OF d (VOLTS DROP PER KW PER MILE AT 110 VOLTS)
EFFECTIVE SPACING OF CONDUCTORS IN FEET
POWER FACTORS
50%
60%
65%
70%
75%
80%
85%
90%
95%
100%
SIZE OF CONDUCTOR
1/0
250,000 C.M.

olution of About 95 Per Cent
Drop Problems

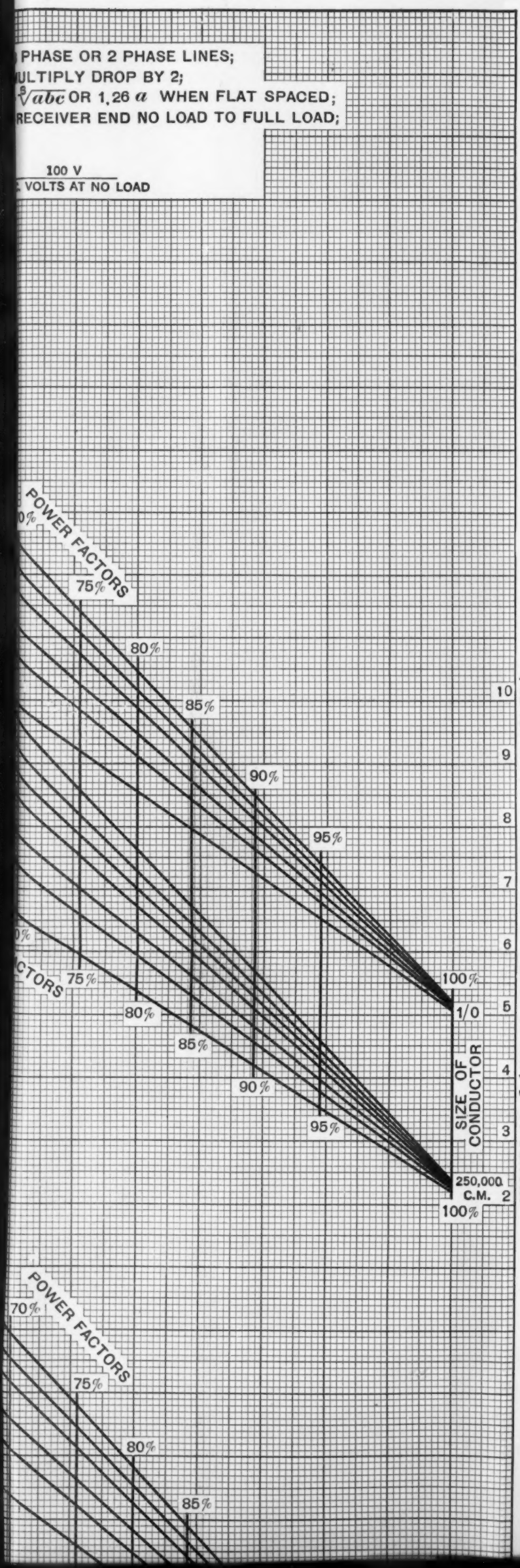
on Page 1238, ELECTRICAL WORLD, May 28, 1921
lectrical department, Utica Gas & Electric Company, Utica, N. Y.



arts for Quick Solution of About
of Line Drop Problems

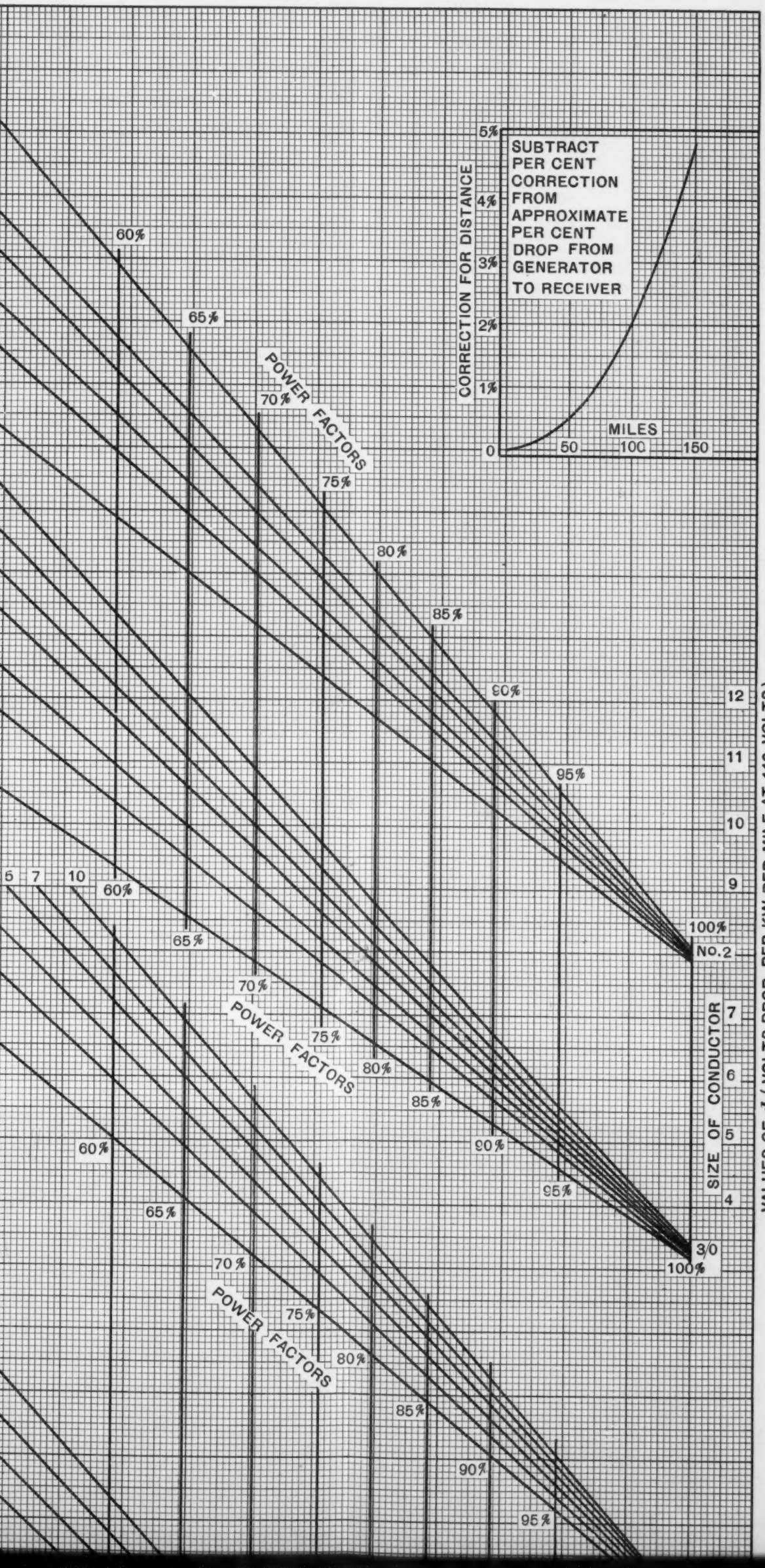
Supplement to Article on Page 1238, ELECTRICAL WORLD, May 28

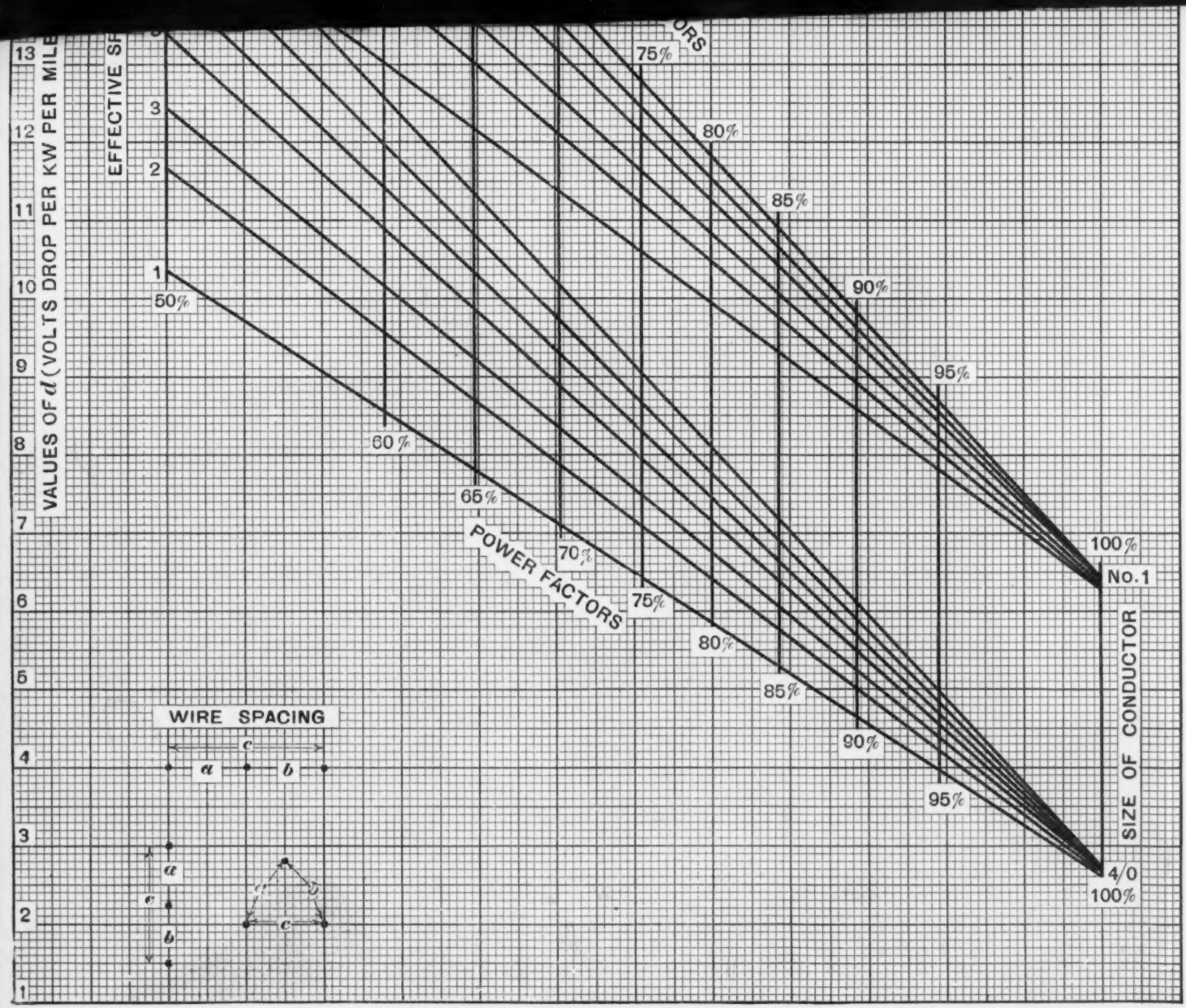
By E. P. PECK, general superintendent electrical department, Utica Gas & Electric

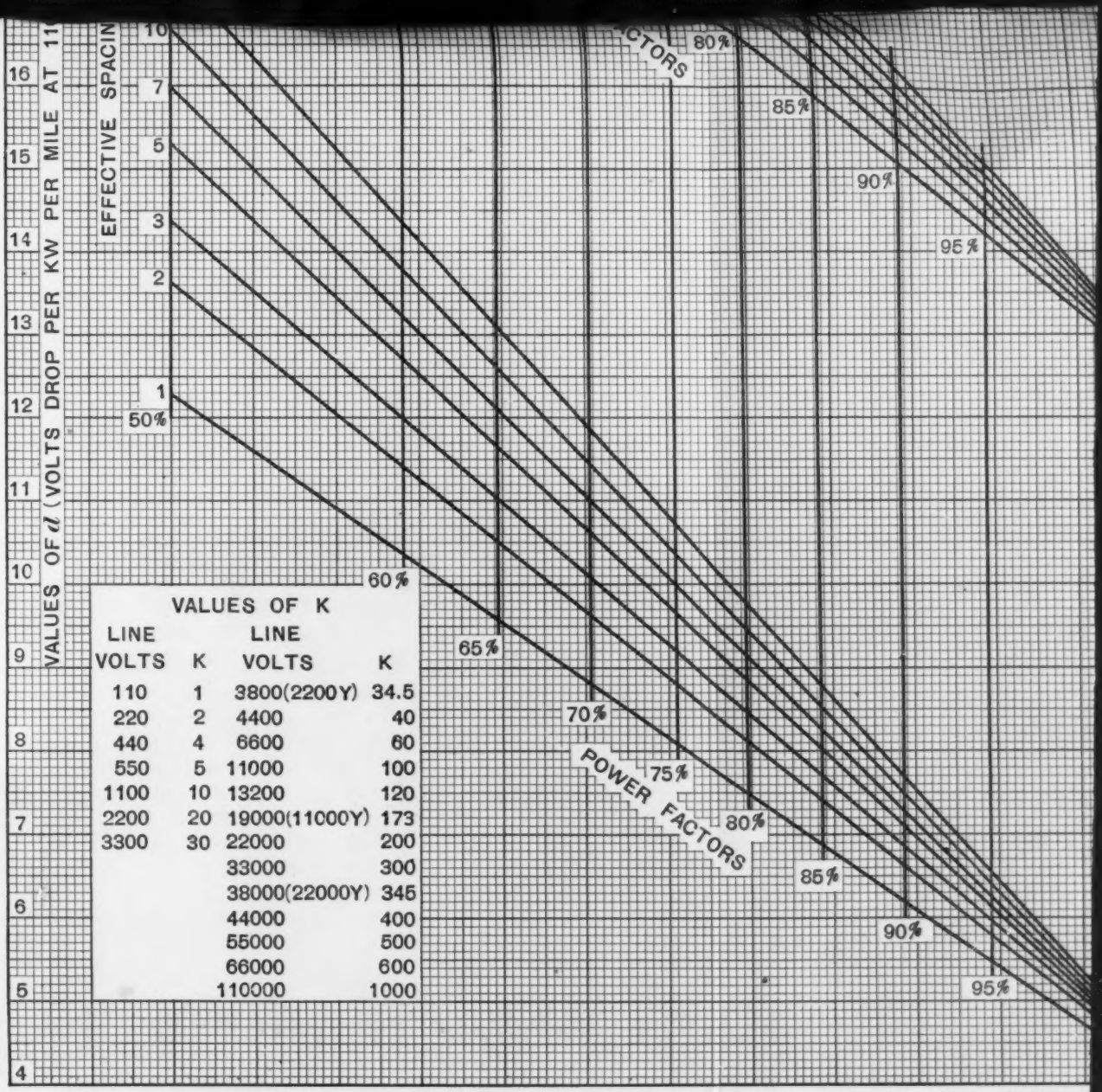


out 95 Per Cent
ems

May 28, 1921
lectric Company, Utica, N. Y.




VALUES OF d (VOLTS DROP PER KW PER MILE
EFFECTIVE SP
ORS
75%
80%
85%
90%
95%
100%
50%
60%
65%
70%
75%
80%
85%
90%
95%
POWER FACTORS
No. 1
SIZE OF CONDUCTOR
4/0
100%
WIRE SPACING
a
b
c
1
2
3
4
5
6
7
8
9
10
11
12
13



VALUES OF K

LINE VOLTS	K	LINE VOLTS	K
110	1	3800(2200Y)	34.5
220	2	4400	40
440	4	6600	60
550	5	11000	100
1100	10	13200	120
2200	20	19000(11000Y)	173
3300	30	22000	200
		33000	300
		38000(22000Y)	345
		44000	400
		55000	500
		66000	600
		110000	1000

SIZE OF CONDUCTOR

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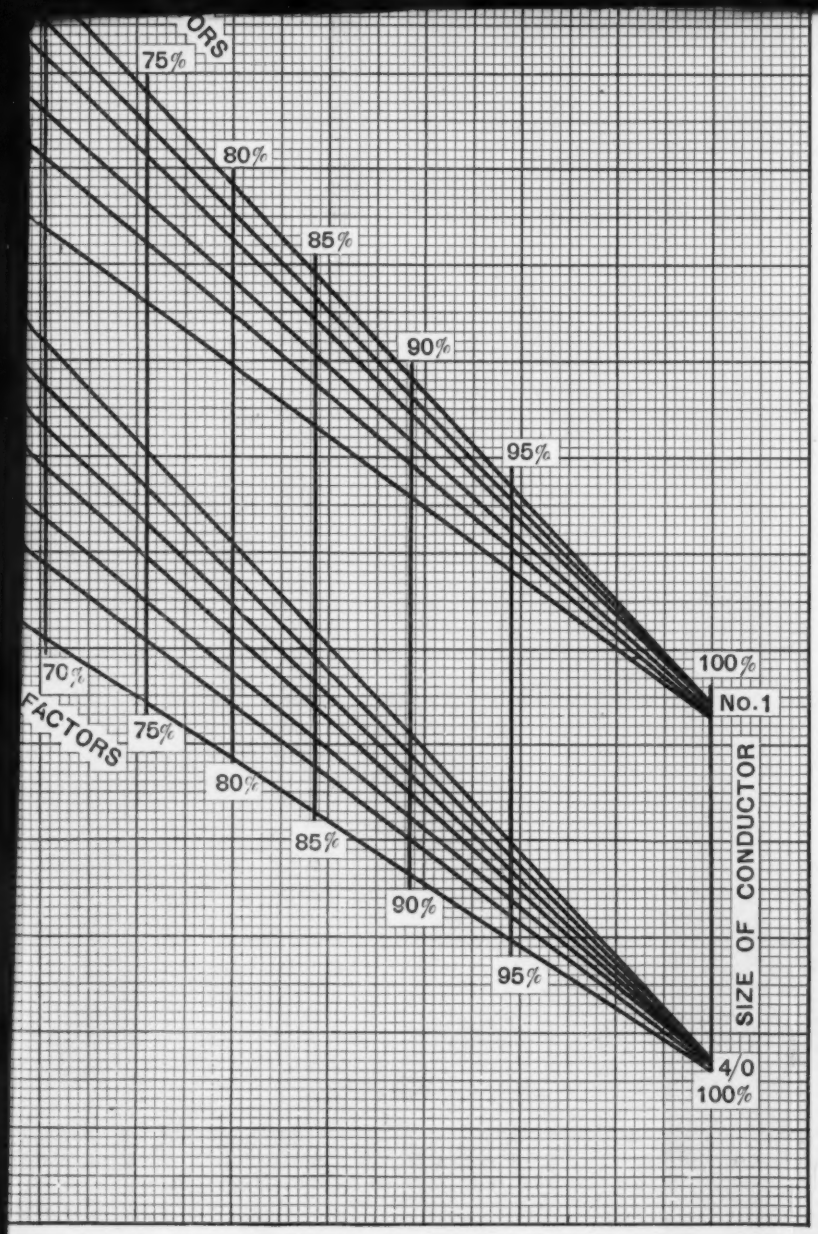

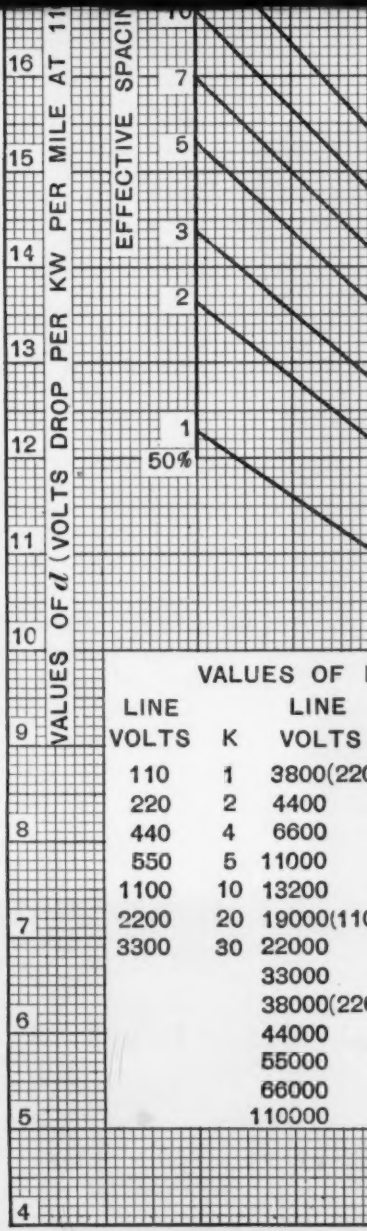

LINE VOLTS	K	LINE VOLTS
110	1	3800(220
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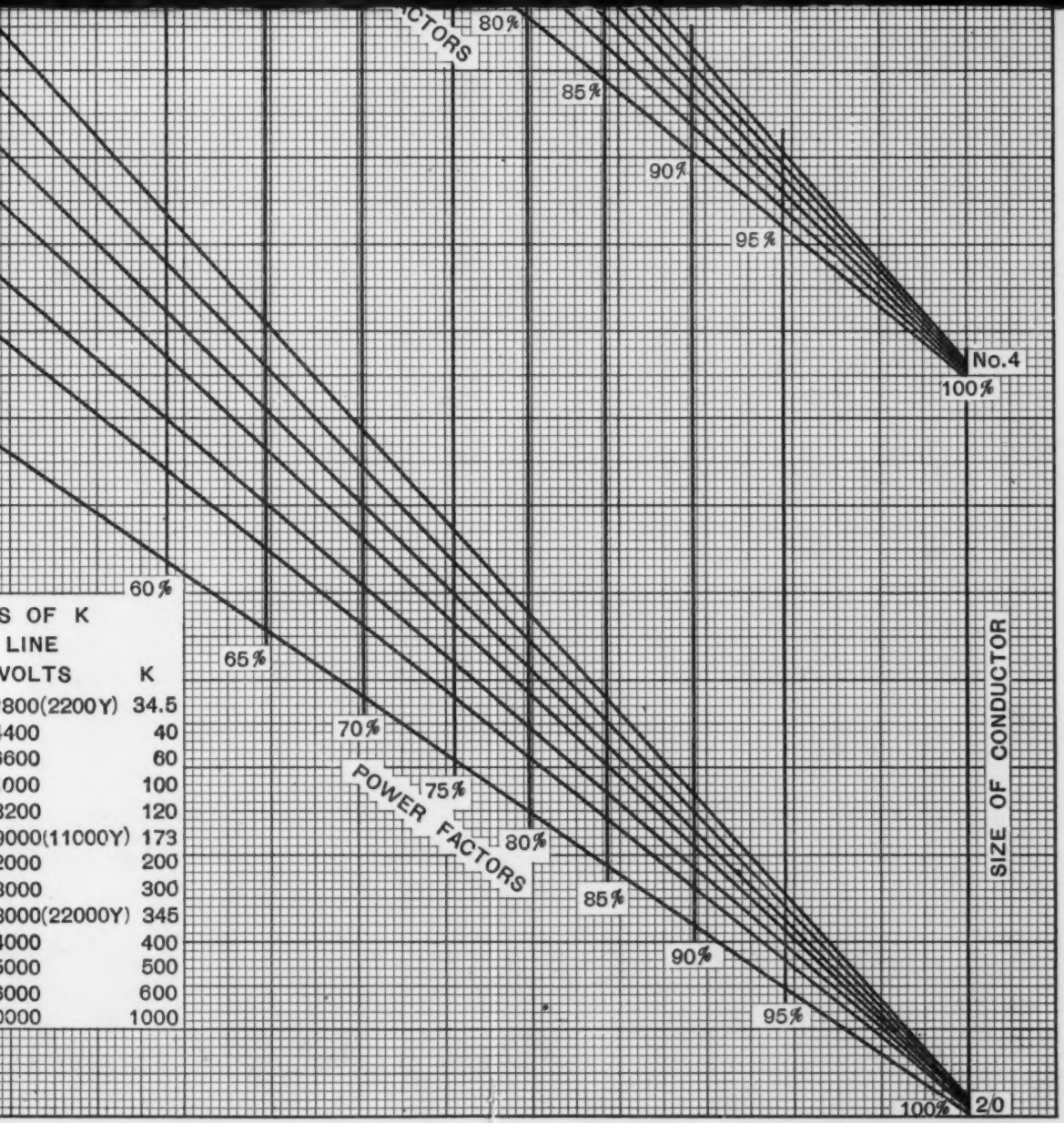
1100	10	13200
2200	20	19000(110
3300	30	22000
		33000
		38000(220
		44000
		55000
		66000
		110000

VALUES OF



S OF K
LINE

VOLTS	K
800(2200Y)	34.5
400	40
600	60
000	100
200	120
000(11000Y)	173
2000	200
3000	300
3000(22000Y)	345
4000	400
5000	500
6000	600
0000	1000

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Charts for Quick Solu
of Line D

Supplement to Article on Pa

By E. F. Price, general superintendent of electric

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Utilizing "Dead" Coils in Motor for Emergency Repair

ALTHOUGH an undesirable disturbance may result from cutting out coils in a motor circuit, the presence of such "dead" coils proved to be a salvation recently in putting a machine back quickly into service after a breakdown. The motor had been originally a two-phase machine and later it was connected for three phases. The usual practice when making such a change without replacing the windings is to cut out a number of the coils so that the winding will be more nearly suitable for the operating voltage. The reason for this is evident since a two-phase winding for a given power, speed and voltage contains one and one-quarter more conductors than a similar three-phase winding.

In the case mentioned two coils were destroyed when a short circuit occurred. Taking into consideration all the difficulties of procuring the wire of proper size, making a form, etc., replacement appeared at first to be no simple proposition. However, as there were twelve idle coils already in the windings it was a quick job to remove two of these "dead" coils from their slots and substitute others for those which had been destroyed.

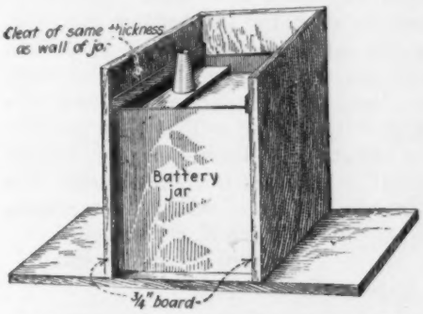
New York City. WILLIAM THOMSON.

How to Open a Storage-Battery Cell

BEFORE opening a cell of a storage battery for inspection or repair both hydrometer and voltage readings should be taken. If a battery has been in a location where dirt might fall on top of the cells, they should be washed with water applied with a hose or a sponge or poured from a bucket. All the vent caps must be in place while washing. Then the ends of the cell connectors are removed from the posts of the cell with a screw-type connector puller, or, if no puller is available, the center of each connector above the post may be drilled with a $\frac{5}{8}$-in. drill to a sufficient depth to allow the connector to be pulled off with pliers. Some find that it is quicker to apply a flame to the top of the connector and melt it just enough to allow it to be pulled off. The removed connectors may be used again. After the connectors are removed from the posts they are bent back so as to be out of the way of the cell when it is lifted from the battery. If the cell sticks it may be loosened by inserting a saw or other thin metal piece between the cell and the tray. It may be necessary to loosen a side piece of the tray. Any free pieces of lead or other material should be carefully brushed off to prevent them from falling into the cell when the cover is removed.

To remove the cover it may be heated by a blow torch or gas flame, by steam or by hot water. Before a flame is brought near a cell precaution must be taken to prevent an explosion of gas and possible injury from acid or pieces of the cover. With the type of cover used with the "Ironclad" battery the electrolyte should be drawn out until it is below the top of the plates. With cells of any type the gas should be blown out with either a low-pressure air hose or a syringe. It is the practice in some shops to add an ounce or two of water to the cell being worked on and to the nearby cells. This is said to lessen danger of an explosion. It is advisable to place a board or asbestos sheet over the tops of the cells near the one being worked on. Sometimes a wet cloth or burlap is employed for this purpose.

If a flame is used, it is run around the compound on the top of the cell until it is soft. When steam is used, a small rubber tube is inserted into the vent and low-pressure steam is allowed to flow for several minutes until the compound is melted. In some cases hot water is allowed to flow through a hose over the tops of the cells for this purpose. Care should be taken that all the vent caps are in place before running on the water. After the compound is melted it is removed with a warm putty knife.



BOX HOLDS DOWN BATTERY JAR WHILE PLATES ARE PULLED OUT

When the compound is removed the putty knife is inserted under the edge of the cover and it is pried loose from the sides of the jar. All bits of compound must be scraped from the inside walls of the jar because these may cause the jar to be broken when the plates are pulled up against them. In the case of cells used in tractors, locomotives, etc., the cover is usually taken off the plates before they are removed. The plates of a smaller cell may be removed from the jar together with the cover. If sealing nuts are used, they are loosened with a special wrench and the nuts and the cover are lifted off. To lift out the plates the jar is gripped between the feet, the two posts are held with large gas pliers and the element is pulled out. If the cover has been removed, small hooks may be used in place of the gas pliers for lifting the plates. These hooks are shaped to take hold underneath the pillar straps beneath the posts. In case the element sticks, the jar may be slid into a box having cleats which fit over the edges of the jar as shown in the accompanying drawing. The man doing the pulling stands upon the boards on either side of the box and the cleats hold the jar down while the plates are being pulled. Sometimes it may be necessary to place the cell in very hot water to within an inch of the top of the jar, which softens the rubber and permits the element to be pulled out.

If it is desired to install new wooden separators the element is placed on edge and the old separators are removed. The new separators are inserted from the bottom, care being taken to push them all the way up

and to see that they are projecting fully on each side of the plates and that none are omitted. If the plates must be taken apart, the separators are first removed and then, holding both posts, the plates are worked apart gradually.

When reassembling the cell the element should be gripped near the bottom in order to keep the plates from flaring out. After it is in the jar the edge of the cover and the inside of the jar are wiped with waste moistened in ammonia to neutralize the acid and the cell is sealed by applying hot compound with a hot putty knife. If the cover has been removed, the posts are wiped with waste moistened with ammonia, rinsed in water and dried thoroughly with clean waste, after which the new cover is put in position. With "Ironclad" cells care must be taken to have the soft-rubber gaskets on the posts under the cover. The sealing nuts are lubricated with a little graphite mixed to a paste with water. The nuts are put on and tightened with a wrench. Grease or vaseline should never be used for lubricating the nuts.

Before replacing the cells in their tray it is well to wash the inside and the upper edge of the tray with ammonia or soda solution. To prevent acid soaking into the top edge of a tray it is painted with melted paraffin around the top and about 3 in. down the sides before replacing the cells. If a jar does not slide easily into place in its tray, it may be lubricated with a little grease.

JAMES H. HENDERSON,
Battery Repair Foreman.
American Railway Express Company,
New York, N. Y.

Wire Sizes for Lines Feeding Induction Motors

THERE is some question in the writer's mind as to whether or not an underwriters' inspector in this district would approve work done in accordance with the table given in the article on "Combined Conduit and Wiring Tables" appearing on page 885 of the ELECTRICAL WORLD for April 16. It is our observation that wire sizes for branches consisting of rubber-covered wire run in rigid iron conduit to feed one squirrel-cage induction motor are usually obtained by assuming a starting current equivalent to two and one-half times the full-load current of the motor and then providing current-carrying capacity for this in accordance with the Underwriters' Table C in the 1920 edition of the code.

If there is more than one motor to be supplied, the general interpretation of the rule is to provide for a total current equal to the starting current of the largest motor plus the full-load currents of the other motors. Using one 30-hp., three-phase, 220-volt squirrel-cage motor, for example, we would assume a starting current of two and one-half times 81 amp., or 202½ amp., and could use a No. 1/0 wire having a Table C carrying capacity of 200 amp. and run in 2-in. conduit. It is probable that No. 2/0 wire run in 2-in. conduit would be used, as the writer has found that for distances such as are to be expected in a large shop or yard the voltage drop is excessive when using wire just large enough to pass the Underwriters' requirements.

Regarding fuse sizes, it is the general practice to fuse branch cut-outs to the capacity of the wire, in this case 200 amp. Without question the 100-amp. fuses indicated in the article would never carry the surge of starting current, but possibly they were meant for use as running fuses shunted during the starting period, and in this case they are correct.

The practice discussed above would, of course, be modified in the case of wound-rotor induction motors having starting resistance which limits the current when starting.

FRANK G. PERLEY.
Allentown, Pa.

Motor Bearings and Oil Must Be Watched Closely

THE oiling system of a motor requires most careful attention because a hot bearing may cause a shut-down. For this reason an inspector should first look at the oil rings and gages and place his hand for a moment on both bearings. If the bearings are hot, that is, so that the hand cannot be held on them, trouble is indicated. Either there is no oil in the bearing, even though the gage is full, or the rings are hindered from turning, owing probably to thickly gummed oil or dirt sediment. If one or both bearings are hot, shut down the motor as soon as notice can be given the operator to remove the load and immediately use plenty of oil, pouring it in through the cap of the bearing and not through the gage. Examine the rings with a light, or feel them with the little finger to make sure that they are free to turn. The motor may then be run; but if there is time to spare, instead of putting oil in at once, remove the gage and bottom plug and allow the old oil to drain off, afterward washing out with gasoline.

Motors in dusty places should have all bearings cleaned out and new oil put in at least once in six months, and oftener if needed. Motors in warm places should have oil with considerable body to it. "Mobile A" is a good oil for warm places, but for motors subject to considerable heat, such as crane service over a furnace, an engine oil which is not very thick will be found good.

For elevator motors in penthouses on the roof and fans and blowers situated outside the main building and subject to very low temperatures a thin oil that will not freeze and clog the rings should be used, such as "Keystone No. 6." No grease or thick oil should ever be used in motor bearings. If a gage or plug leaks, the oil is likely to be exhausted before it is noticed; therefore one should look carefully for leaks, especially from broken or loose glass tubes. No motor should be run with its bearing caps open, as dust will certainly collect, especially at the pulley end, where the belt or chain acts like a conveyor.

Oil for relays and starting compensators must not be used as a lubricant, as it is far too thin. Thick oil should not be thinned with kerosene, as kerosene cuts and does not help to lubricate. If a bearing has run so hot as to smoke, it is very likely somewhat worn, and a careful test with a steel gage should be made.

Look for a somewhat rare fault, that of the sleeve turning upside down, thus preventing the rings from running in their slots, the result, of course, being extreme heat. This trouble is generally caused by the set screw working out of place. If a motor has recently been taken apart, there is a chance that the rings have been bent and the bearings may run hot as a consequence.

H. S. RICH.
East Berlin, Conn.

Switchboard Made of Standard Parts Is Compact and Safe

OWING to limited space it was impossible to install a regular slate switchboard with knife switches or oil switches in a substation of the Union Switch & Signal Company, Swissvale, Pa. However, a neat, compact and safe board was built of safety switches supported on pipes, as illustrated in the photograph. This is a three-phase, 60-cycle, 440-volt distributing switchboard. The switchboard frame was set 3 ft. from the wall to allow a passageway. The framework was made of 1¼-in. iron pipe, using standard malleable-iron switchboard frame fittings fastened to the pipe by ⅜-in. U-bolts. The frame work is 10 ft. long x 8 ft. high and has one 1¼-in. pipe at each end and one in the center of the frame to which the cross pipes supporting the switches are mounted with pipe cross clamps, there being one cross-pipe at top and bottom of each switch.

The switches are spaced 8 in. apart horizontally to allow opening the door for replacing fuses and inspecting. They are spaced 6 in. apart vertically to allow for condulets coming out at the top of the switches. The switch boxes are fastened to four standard mounting brackets, which are attached to the frame with ⅜-in. U-bolts.

The four switches at the top are each 400-amp., 600-volt fused-bottom switches. The four lower switches are 200-amp., 600-volt fused-bottom switches. The connections from top of switch to busbars are made with rubber-covered cable. The 400-amp. switches are connected with 500,000-circ.mil cable cable run through short pieces of 3-in. conduit at the top end of which is a type "A-88" condulet with three-hole composition cover. The 200-amp. switches are connected by No. 4/0 cable, run through 2½-in. conduit using one "L.R.-77" condulet and one "L.B.-77" condulet at the top of the box to bring the 2½-in. conduit up behind the 400-amp. switches. The wires are brought out through a type "A-77" condulet with a three-hole composition cover. The connections to busbars are made with standard clamp bus terminals.

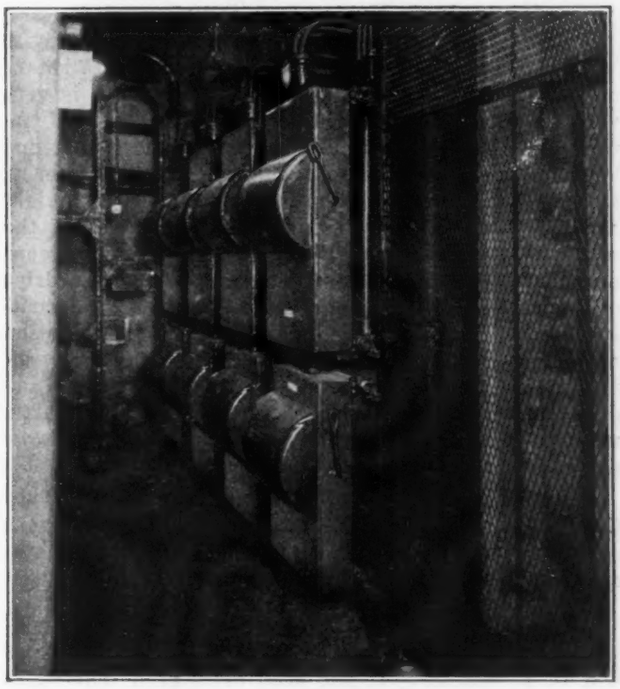
The branch conduits feeding the various circuits are all brought out at the lower left-hand side of the switches, using an "L.R." condulet next to the box to turn the conduit upward. The conduits are run up and turn toward the end wall with standard conduit elbows, and are run underneath the wall brace supporting the busbars and back to the wall to a sheet-steel junction box whence conduits to various circuits radiate.

The eight switches on this board control circuits to which is connected 620 hp. in motors. The board is in the basement of a power house where there is a space of only 7 ft. 6 in. from transformers to wall. The installation leaves 3 ft. 4 in between the front of the switches and the transformers, which is sufficient room to remove a transformer in case of trouble. The framework has been built so that additions can be made when more circuits are required.

F. W. MCGRAW,
Chief Electrician.
Union Switch & Signal Company,
Swissvale, Pa.

LIST OF MATERIAL USED IN CONSTRUCTING THREE-PHASE, 60-CYCLE, 440-VOLT SAFETY SWITCHBOARD

Four No. 56,365 400-amp., 600-volt "square D" switches.
Four No. 56,364 200-amp., 600-volt "square D" switches with end plates.
Thirty-two No. 112,878 pipe-mounting brackets, complete with ⅜-in. mounting bolts, Westinghouse Electric & Manufacturing Company.
Fifteen No. 216,509-A pipecross clamps, 1¼-in. pipe, W. E. & M. Co.
Three No. 225,654 pipe flanges, 1¼-in. pipe, W. E. & M. Co.
75 ft. 1¼-in. black iron pipe.
Twelve No. 238,467 bus supports with 1¼ in. pipe-frame mounting, W. E. & M. Co.
Twenty-four No. 196,397 busbar clamp terminals, W. E. & M. Co.
Nine pieces ¼ in. 3x10 in. hard-drawn copper busbar.
45 ft. No. 500,000-circ. mil. R. C. D. B. copper cable, N.E.C., 600-volt.
100 ft. No. 4/0 R. C. D. B. copper cable, N.E.C., 600-volt.
Six No. 330,333 busbar clamps, Electrical Engineer Equipment Company.
Five No. L.B.-66 condulets, complete with No. 600 covers.
Four No. L. R.-66 condulets, complete with No. 600 covers.
Four No. L.B.-77 condulets, complete with No. 700 covers.
Four No. L.R.-77 condulets, complete with No. 700 covers.
Four No. A-8 condulets with No. C.F.-83 covers.
Four No. A-6 condulets with No. C-F-63 covers.
Four 3-in. conduit lock-nuts.
Four 2½-in. conduit lock-nuts.
Eight 2-in. conduit lock-nuts.
Four 3-in. conduit bushings.
Four 2½-in. conduit bushings.
Eight 2-in. conduit bushings.
2 ft. 3-in. conduit.
15 ft. 2½-in. conduit.
36 ft. 2-in. conduit.
Six ¼x4-in. U.S. expansion bolts with shields.
Six ¼-in. "U" bolts with hexagonal nuts.
Labor—Two electricians and one helper, 18 days, 8¾ hours each.



SPACE ONLY 3 FT. 4 IN. DEEP IS TAKEN BY THIS SWITCHBOARD FOR 1,600 AMP. AT 440 VOLTS, THREE-PHASE

Shield for Protecting Drop Cable of Crane Magnet

ON ACCOUNT of the sag usually present in the drop cable of an electric lifting magnet, it sometimes loops under the magnet or gets caught on some obstruction. Such an accident is likely to cut the cable or bruise the insulation. Sometimes an electrically operated bucket is suspended on the hook instead of the magnet and the same cable is used through different controllers. In this case injury is especially frequent owing to the great weight of the bucket and extremely rough handling.

To afford protection against such injury the writer employs a 15-ft. flexible steel hose slipped over the cable next to the magnet. The hose is flexible enough to wind around the drum nicely. Of course, the hose will in time become dented and badly crushed, but the cable will still be safe inside.

HERBERT J. WOLF.
New Haven, Conn.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Applications for the Small Rotary Converter.—L. VADOT.—The author deplores that the small-size rotary of from 5 kw. to 50 kw. output or thereabout is very rarely used, although it possesses a great many advantages. As such are mentioned its small first cost and low energy consumption on account of higher efficiency, as compared with the motor-generator, its small weight and floor space and its high power factor. Among the many uses where a small rotary proves advantageous are enumerated the charging of storage batteries, drive of variable-speed direct-current motors from alternating-current lines, motion-picture arc lamps, operation of lifting magnets and magnetic chucks, electric welding, X-ray apparatus, using alternating current and direct current at the same time, and radio apparatus, using high and low potential at the same time.—*Revue Générale de l'Électricité*, March 26, 1921.

Theory of the Three-Phase Variable-Speed Shunt Commutator Motor.—J. L. D. RIDSDALE.—A treatment of this subject by means of vector diagram and mathematical analysis.—London *Electrician*, April 15, 1921.

Lamps and Lighting

Flame Excitation of Luminescence.—E. L. NICHOLS and D. T. WILBER.—It has been discovered that many substances may be excited to fluorescence by contact with a hydrogen flame. The conditions for this excitation are described, and it is shown this luminescence differs from photo-luminescence, also from mere temperature radiation.—*Physical Review*, April, 1921.

Safety Features of Industrial Lighting.—SAMUEL G. HIBBEN.—In general, according to this paper, bad lighting is caused by one or both of two outstanding factors—(1) bare incandescent lamps, or unshielded glaring illuminants that not only do not illuminate but cause a contraction of the pupillary opening of the eye and resultant decrease in seeing ability; (2) insufficient light, which is largely due to improper lamp renewals, wrong methods of reflector and lamp cleaning, color of surroundings, or lack of efficiency in maintaining the original installation up to its initial standard. The latter factor particularly is discussed in this article.—*Transactions of Illuminating Engineering Society*, April 30, 1921.

Generation, Transmission and Distribution

Hydro-Electric Unit Operated from City Water Main.—J. B. HOLDCROFT.—A unique installation at Port Alberni, B. C., is described, where high pressure and large pipe capacity permitted a waterwheel to be attached to the water main, a municipal lighting plant being operated by this means.—*Canadian Electrical News*, April 1, 1921.

Storing Up a Year of Power.—W. L. ABBOTT.—In this article the storage and handling of coal with particular reference to prevention of fires is dealt with. Six important points are brought out as follows: (1) Coal should never be subjected to heat from outside sources, such as hot pipes, boilers and so on. (2) Foreign combustible material should be kept out of the pile. (3) The coal should be piled in uniform sizes and segregation prevented. (4) Sized coal only should be stored, if possible. (5) It is immaterial whether the storage is under cover or in the open. (6) The greatest liability to fires seems to be within the first three or four months, and during that time special care should be taken to watch the pile for evidences of combustion.—*Factory*, April 15, 1921.

Economics of Hydro-Electric Development.—A. H. GIBSON.—The possibility of economic development of a hydro-electric scheme depends essentially upon (a) whether there exists or is likely to exist a market for the energy; (b) whether the price at which the energy can profitably be sold is, first, such as the industry can afford to pay and, second, less, or at least not greater than, the price of energy from a fuel-operated station. Some figures are given to show the depreciation rate which should be applied to various elements of hydro-electric systems. These are in percentages of first cost of the installation, as shown in table:

	Per Cent
Civil engineering works, including dams, conduits, headworks, power house, etc	1.5
Pipe lines and sluicegates	2.5
Electric generators, transformers and switchgear	4.0
Hydraulic turbines and governors	4.5
Transmission lines:	
Towers	3.0
Cables	5.0
Insulators	10.0
Operating machinery in power-house cranes, hoists, etc.	6.0

Reports from the Swedish government are quoted showing the annual operating cost excluding depreciation to average slightly over 12 shillings per turbine-horsepower installed. The first cost and fixed charges are also discussed.—London *Engineer*, April 8, 1921.

Traction

Recent Railroad Electrification.—The recent electrification of a short railroad line in northeastern Oklahoma is held to afford another proof of the advantages of electricity as motive power on railways. The line is said to give excellent freight and passenger service to zinc and lead mining communities. The early extension of the electrification is contemplated.—*Electric Railway Journal*, May 7, 1921.

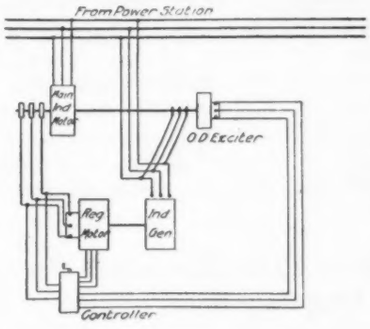
The Electric Locomotives of the Gotthard Railway.—A. MARSHALL.—The article described in detail the freight and passenger locomotives of this railway, which was opened for electric traction in September, 1920. The 15,000-volt, 16⅔-cycle machines are operated by 60,000-volt, three-phase current. All data are given for the types 1C1, 1B+B1, 1C+C1, built by Oerlikon and by Brown, Boveri in Switzerland. The Oerlikon machines use regenerative braking.—*Zeitschrift des Vereines Deutscher Ingenieure*, April 2, 1921.

Installations, Systems and Appliances

X-Rays and Their Industrial Applications.—An abstract of three lectures by G. W. C. Kaye dealing with developments and limitations of X-ray apparatus for various industrial applications.—London *Engineering*, April 8, 1921.

Considerations in Motor Applications.—PHILIP CHAPIN JONES.—The writer considers the relation of power factor and efficiency to the rated load. Motor loads are grouped into three classes, and heating effects of variable loads and overloads are considered.—*Power*, April 5, 1921.

Some Methods of Obtaining Adjustable Speed with Electrically Driven Rolling Mills.—K. A. PAULY.—After outlining the speed requirements of steel rolling mills, disclosing the need in many cases for adjustable speed over a wide range, the author goes into a discussion of the merits of the Scherbius system of speed control, both single-range and double-range, in which the slip energy of the main motor is returned to the system as



DOUBLE-RANGE SCHERBIUS SYSTEM FOR INDUCTION MOTOR SPEED CONTROL

electrical energy. A comparison is made with the Kraemer or synchronous converter system in which the slip energy is returned to the main motor shaft. The double-range Scherbius system permits of satisfactory operation at speeds below synchronism, at synchronism and above synchronism, which is said not to be practicable with the Kraemer system.—*General Electric Review*, May, 1921.

Electrophysics and Magnetism

The Thermionic Current Between Parallel Plane Electrodes.—THORNTON C. FRY.—The electrical equations applying to the velocities of thermionic emission distributed according to Maxwell's law are developed without neglecting the distribution of initial velocities, which in the first place is allowed to be entirely general. Maxwell's distribution of velocities is then considered in detail and a complete solution obtained.—*Physical Review*, April, 1921.

Measurements of Heat Conductivity of Insulations Used on Conductors in Turbo-Alternators.—P. JANET.—To determine the exact temperature gradient of the layer of insulation upon a conductor, several tubes of copper were covered with different insulating materials, such, for example, as mica and its derivatives. Calibrated thermocouples (copper-argentan) were placed next to the conductor, and on top of the insulation the tube was electrically heated, and readings were taken on a potentiometer connected to the couples. Extreme care was taken to obtain as exact and reliable data as possible. Mathematical derivations and tabulations of actually observed values are given in the paper. At the same time some dielectric tests of the insulation were made before and after the heat runs. Heating to 150 deg. C. for one hour did not seem to have any detrimental effect upon the insulation.—*Revue Générale de l'Électricité*, March 19, 1921.

Electrochemistry and Batteries

Instantaneous Current and Voltage Values in a Battery.—G. W. VINAL and C. L. SNYDER.—A study of storage-battery performance in lighting, ignition and starting service for automobiles. The study was made in the Bureau of Standards at the request of the Motor Transport Corps. Extensive oscillographic records are shown for typical automobile service.—*Journal of Society of Automotive Engineers*, April, 1921.

Designing the Storage-Battery Locomotive to Meet Conflicting Needs.—C. W. SMITH.—Complications in the problem of the design of the accumulator locomotive are discussed with the object of showing how the greatest possible reliability and battery capacity are attained.—*Coal Age*, May 5, 1921.

Telegraphy, Telephony and Signals

Failure of Lead Sheathing of Telegraph Cables.—L. ARCHBUTT.—An examination of some lead sheaths which had failed, apparently owing to inter-crystallizing fracture, were examined to determine the effects of vibration and mechanical handling on the failure of such sheaths.—London *Engineering*, April 8, 1921.

Radio Service from Paris to London.—Stations for regular communication between these two cities are located in Neuilly-Levallois, France, and Chelmsford, England. A high-frequency generator of 10 kw. to 25 kw. is used for sending. Signals are first recorded by perforation by means of a special machine upon a strip of paper and are then sent at about a hundred words per minute. The received messages are considerably amplified and are registered upon a fast-rotating wax disk similar to that of a phonograph. For transcribing, the disk is revolved much more slowly, to enable the operator to copy the message on a typewriter.—*Radioelectricité*, Vol. I, page 404.

Some Operating Characteristics of Electron Tubes.—W. C. WHITE.—It is the author's purpose not to take up the fundamental theories of operation of the tube or its circuits, but to furnish information and give help to those who professionally or otherwise experiment with these devices.—*Journal Franklin Institute*, April, 1921.

The Cathode-Ray Oscillograph and Its Application in Radio Work.—LEWIS M. HULL.—The general construction and details of the design of cathode-ray tubes are given. The brightness of the spot obtained, the sensitivity of the tube and its behavior in use are described. The various excitation sources available are compared. A number of applications of such tubes to radio research (for example, spark-gap characteristics and associated synchronizing of oscillating triodes) also are dealt with.—*Proceedings Institute of Radio Engineers*, April, 1921.

Behavior of a Three-Electrode Vacuum Tube as an Oscillation Generator.—EIJIRO TAKAGISHI.—The writer states that the subject should be handled by starting from the dynamic or derived characteristics. These differ greatly from the static characteristics, which can be experimentally determined with ease. The writer then proceeds to derive mathematically the characteristics solely from the circuit conditions.—London *Electrician*, March 25 and April 1, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

J. M. Beck to Be Principal Speaker on N. E. L. A. Public Policy Night

ANNOUNCEMENT was made early this week that James Montgomery Beck, who was Assistant Attorney-General of the United States under Presidents McKinley and Roosevelt and has been recently appointed to be Solicitor-General, has been selected as the principal speaker on public relations night at the National Electric Light Association convention in Chicago next week. Mr. Beck achieved an international reputation before America's entrance into the war by his keen analysis of the documentary statements of their cause made by European governments and the conclusive showing of the strength of the Allies' position that he founded thereon.

The state committees on public utility information have arranged an exhibit to be held in one of the convention hotel rooms of all the material that they have prepared.

On Wednesday reports from Chicago were to the effect that more than 1,100 member companies had made advance reservations and it was estimated that the attendance would reach 4,000.

Duquesne Light Offers $10,000,000 in Debentures

BEARING date of July 1, 1921, an issue of $10,000,000 in fifteen-year 7½ per cent convertible gold debentures of the Duquesne Light Company of Pittsburgh is announced. The price of the issue is 98½, which means that the investment will yield 7.65 per cent. The proceeds of the issue will be used for acquiring the fee ownership of the Colfax plant, for the acquisition of the extensive coal properties from which it obtains its fuel supply and for other extensions and additions to the property.

William McClellan Elected President of A. I. E. E.

AT THE annual meeting of the American Institute of Electrical Engineers, held in New York on May 20, results of the recent election were announced, showing that Dr. William McClellan, for many years a prominent engineer, educator and utility executive, had been elected president for the year beginning Aug. 1, 1921. President Berresford called upon Dr. McClellan, who spoke briefly of the important part which engineers should play in restoring business to a normal condition. The building up of our foreign trade was a pressing necessity, he said, since only 70 per cent of the nation's production is needed at home. Following the lead of Herbert Hoover, engineers should play a leading part in the development of such commerce.

The complete list of officers elected follows:

President—William McClellan, Philadelphia.

Vice-presidents—Walter A. Hall, Boston; N. W. Storer, Pittsburgh; William A. Del Mar, Yonkers, N. Y.; C. G. Adsit, Atlanta; John C. Parker, Ann Arbor, Mich.; F. W. Springer, Minneapolis; H. W. Eales, St. Louis; Robert Sibley, San Francisco; O. B. Coldwell, Portland, Ore., and F. R. Ewart, Toronto.

Managers—A. G. Pierce, Pittsburgh; R. B. Williamson, Milwaukee, and Harlan A. Pratt, New York.

Treasurer—George A. Hamilton, Elizabeth, N. J. (re-elected).

The above, together with the following hold-over officers, will constitute the board of directors for the next administrative year: A. W. Berresford, Milwaukee; Calvert Townley, New York; Walter I. Slichter, New York; G. Faccioli, Pittsfield, Mass.; Frank D. Newbury, Pittsburgh; L. E. Imlay, New York; F. F. Fowle, Chicago; L. F. Morehouse, New York; Harold B. Smith, Worcester, Mass.; James F. Lincoln, Cleveland, and E. B. Craft, New York.

At the meeting of the board of directors held on the same date F. L. Hutchinson was re-elected secretary of the Institute.

California Cities Plan Municipal Power Development

THE cities and organized rural districts of California will undertake the municipal development and ownership of hydro-electric power on a large scale if the plans of the League of California Municipalities are carried out. These were detailed at a meeting of the league held in Sacramento May 20, which was attended by more than fifty mayors and other officers of California cities. The purpose of the meeting was to prepare for the initiation of an act similar to the Johnson act to be placed on the next general California ballot in the fall of 1922. The Johnson act as originally prepared was written largely by officers of the league.

Governor Stephens addressed the meeting and stated that while fair returns for the honestly invested capital of privately owned public utilities should be protected, yet he hoped that districts, cities and counties would be enabled to develop hydro-electric power. Although Senate bill No. 397, known as the Johnson act, and which was designed to create a hydro-electric power commission modeled after the Ontario commission, was defeated in the State Assembly during the recently closed session of the Legislature, an act known as Senate bill No. 18, legalizing co-operative organizations of and between political subdivisions of the state which wish to join in certain undertakings, was passed. This bill has been signed.

Secretary Mason of the league asserted that the time was rapidly approaching when the diminishing supply of oil and the consolidation of the power companies would place the industries of the state under the control of the power companies.

C. H. Lee, president of the California Water Commission, said that while there was approximately 9,500,000 hp. of water power in California possible of develop-

ment, 1,000,000 hp. was developed and applications were filed for an additional 7,000,000 hp., of which 65 or 70 per cent was sought by corporations of which about half are now operating and the remainder are newly organized.

The league voted to draft an agreement under the authority of Senate bill No. 18 to form organizations to study the situation as regards sites and prepare for power development when this authority was granted; to have the state engineer, the president of the state Water Commission and C. L. Seavey, Sacramento city manager, empowered as trustees of the power interests of the municipalities to raise funds for organization, for locating power sites, for arousing public sentiment by publicity, investigating methods of obtaining power sites, drafting initiative measures and campaigning for their passage.

F. M. Feiker Guest of Westinghouse

OFFICIALS of the Westinghouse Electric Manufacturing Company tendered on Monday a complimentary luncheon to Fred M. Feiker, vice-president of the McGraw-Hill Company, who this week went to Washington to assist Secretary Hoover in the development of the Department of Commerce as an aid to American industry.

Mr. Feiker outlined the need for Government assistance to industry in the gathering of essential facts and figures and presenting them properly to business men. Gen. Guy E. Tripp, chairman of the board of the Westinghouse company, and James H. McGraw, president McGraw-Hill company, spoke of the value of such a plan and remarked on the peculiar fitness of Mr. Feiker to undertake the work. A. A. Brown, assistant sales manager of the Westinghouse company, acted as toastmaster. Those who gathered to honor Mr. Feiker were General Tripp, L. A. Osborne, vice-president Westinghouse company; J. H. McGraw, M. S. Sloan, president Brooklyn Edison Company; A. E. Allen, manager New York Westinghouse office; F. W. Smith, vice-president and general manager United Electric Light & Power Company; J. W. Lieb, vice-president and general manager New York Edison Company; Charles A. Terry, vice-president Westinghouse company; M. H. Aylesworth, executive manager National Electric Light Association; Henry L. Doherty, president Henry L. Doherty & Company, and A. A. Brown.

The Ninth Chicago N. E. L. A. Convention

THE forty-fourth convention (the ninth in Chicago) of the National Electric Light Association opens at the new Drake Hotel, on the shore of Lake Michigan, Monday night, with meetings of the executive committees of each of the national sections.

Each morning will be devoted to general sessions.

Tuesday, Wednesday and Thursday afternoons will be given over to the four national sections, some of which will hold parallel sessions.

The president's reception will be on Tuesday night; the dinner, entertainment and dance on Wednesday night, and public policy night on Thursday, with James Montgomery Beck as principal speaker.

In all seventy-two reports, papers and addresses are scheduled for presentation. Of these thirty-five have been printed.

There are no manufacturers' exhibits this year, but the Lighting Sales Bureau has arranged a demonstration of residence lighting.

A big electric vehicle show will take place during the week at the showrooms of the Commonwealth Edison Company.

The Chicago committee on arrangements is doing everything to make the 1921 convention eclipse all others. The last Chicago convention was in 1916 under the administration of E. W. Lloyd.

The first N. E. L. A. convention was also in Chicago in 1885, when J. F. Morrison was president. The membership at that time was 87; today it is over 11,000. The other Chicago conventions were in 1889, S. A. Duncan president; 1898, Samuel Insull president; 1900, S. T. Carver president; 1903, Louis A. Ferguson president; 1908, Dudley Farrand president, and 1913, F. M. Tait president.

Electron Tubes Soon in Heavy Power Service, Dr. Hull Predicts

"ONE year will see these tubes [electron tubes] in use as kenetron rectifiers for series arc lighting. Five years will see them in substations replacing rotary converters. In ten years they will be on electric locomotives, either as rectifiers, allowing the use of direct-current motors, or as variable-frequency alternators, taking their power from a high-tension, direct-current trolley line. Twenty years will see direct-current transmission lines, fed through transformers and kenetrons, at any convenient point by alternators of any frequency, and tapped by the same tubes acting as magnetron alternators, as some equivalent pliotron or combination alternator." Such was the startling prophecy of Dr. Albert W. Hull of the research laboratory, General Electric Company, before the A. I. E. E. at its annual meeting in New York on May 20.

Dr. Hull described the new vacuum tube, which is called "magnetron" because the valve control is accomplished by means of a magnetic field. Although the magnetron has been used only for weak currents, he showed a magnetron tube with an anode 4 in. (10 cm.) in diameter and 12 in. (30 cm.) long which had been operated at 5 kw. output. With larger filaments and water cooling, these tubes would be capable of handling hundreds of amperes.

No Hope for National Daylight Saving

IT HAS been decided by the committees of Congress having jurisdiction over daylight-saving bills that the subject is not to have consideration. This puts an end to the attempt to make daylight saving again national during the coming summer.

Right of Eminent Domain Granted to Indiana Utilities

PUBLIC utilities in Indiana are authorized by a law recently signed by the Governor to appropriate and condemn for their use lands of individuals and private corporations or any easements in such lands wherever such action is necessary to the carrying out of their objects. The utilities affected by the law include those engaged in the production, transmission, delivery or furnishing of heat, water, light, power and telegraph and telephone service. The law specifies that wherever

land, except in cities of the third class, is needed for the placing of buildings, structures, dams, pole lines, wires, mains, conduits, pipe lines and right-of-way this action may be taken with the approval of the Public Service Commission. It provides, however, that within the limits of an incorporated town or city the authority to appropriate does not extend to lands situated in any city block in which more than 50 per cent of the frontage is devoted to residence purposes. Utilities are also prohibited from appropriating lands within the corporate limits of a city for overflowage by backwater from a dam.

Boiler-Test Figures Using Pulverized Fuel Presented Before A. S. M. E.

INTERESTING figures on boiler tests made at the new Lakeside plant of the Milwaukee Electric Railway & Light Company were presented by Henry Kreisinger, in a paper on boiler tests, before the annual convention of the American Society of Mechanical Engineers at Chicago on Tuesday. The Lakeside plant is constructed for the use of pulverized coal only. Tests were carried out on the 1,306-hp. Edge Moor four-pass boilers, of which there are eight, each having 7,200 cu.ft. of combustion space and capable of burning 7 tons of fuel per hour at the maximum rating. On one test of forty-four hours at 138 per cent rating a boiler efficiency of 83.4 per cent and a combined boiler and economizer efficiency of 86.3 per cent were obtained. On a twenty-four hour test at 214 per cent of rating the figures were 82.3 and 86.8 per cent respectively. One test of twenty-four and one-half hours at 135 per cent of rating showed a boiler efficiency of 85.6 per cent and 90.2 per cent for the boiler and economizer combined. No deductions for boiler auxiliaries are made in these figures.

On a boiler operating at 137 per cent of rating fluegas temperatures of 432 deg. leaving the boiler were recorded, with 392 and 250 deg. entering and leaving the economizer. Mr. Kreisinger also expressed the opinion, based on experience, that it was not necessary to dry coal to about 1 per cent of moisture for pulverizing and drying and further said that most Eastern coals can be pulverized and burned with good results without drying.

John A. Stevens of Lowell cited the practice followed in Europe of preheating combustion air, and Mr. Kreisinger indicated that the practice might offer an increase in efficiency of 3 per cent, though in the cases with which he was dealing the combustion air was circulated through the furnace walls to prevent heat radiation and was therefore preheated to a considerable degree.

John H. Wilson of Chicago and E. H. Tenney of St. Louis at the fuel session on Tuesday discussed the capacity efficiency and limitations of stokers using Middle West coals.

E. G. Bailey of Cleveland outlined results from experiments with a temperature-recording device to determine ashpit losses from chain-grate stokers. The device is a steel tube or bulb filled with nitrogen and connected through a capillary tube to a recorder made up of a mercury U-tube, one leg of which is open to the atmosphere and carries a float to which the recorder pen is attached. When properly placed near the rear of the stoker its temperature seems to bear a definite relation to the amount of combustible going into the ashpit.

No Water-Power Valuations Until Personnel Is Provided

PENDING authorization by Congress permitting the employment of properly qualified engineers and accountants, the Federal Power Commission will make no effort to undertake valuations of projects already constructed. This course of action was decided upon by the commission at its meeting on March 20. The commission believes that for valuation work a personnel with specialized technical training and experience is needed. Persons with the necessary qualifications have not been assigned to the commission. In cases of this kind a license is to be issued under the condition that a valuation shall be made at the earliest practicable date and that it shall be determined as of the date of the license.

The commission has voted to recommend legislation to permit it directly to engage its personnel in addition to utilizing some of the specialists of the Departments of War, the Interior and Agriculture. In fact the commission approves the identical bill to this effect which was introduced at the last session by Representative Esch. This bill also provides for an increase in the salary of the executive secretary from $5,000 to $7,500 per annum and amends the acts in other minor particulars

States Provide for Colorado River Development Commissioners

THE governors of the states in the Colorado River basin have presented a resolution to Congress pointing out that Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming have by appropriate legislation authorized the appointment of commissioners representing these states for the purpose of entering into an agreement between these states and the United States respecting the future utilization and disposition of the waters of the Colorado River and of its tributaries. The governors urge that Congress provide for the appointment of commissioners on behalf of the United States.

Georgia Electrical Men Organize for Co-operation

MEN from all branches of the electrical industry gathered together at Macon, Ga., on May 9 and 10 to organize a state co-operative association. A few of those attending the meeting were grouped together for this photograph. More complete details of the meeting will be found on page 1177 of the May 21 issue.

Municipal Light Plant Bonds Legalized by Indiana Legislature

A LAW recently signed by the Governor of Indiana legalizes the acts of boards of trustees of incorporated towns in that state in borrowing money for the purpose of installing and maintaining municipal light and water plants and in paying the interest on such debts out of general funds. It provides also that where the State Board of Tax Commissioners has issued orders permitting the issuance of the bonds the issue shall be valid.

Pacific Coast N. E. L. A. Invites Outside Interests to Convention

AN INNOVATION is to be made at the annual convention of the Pacific Coast Section of the National Electric Light Association this year in that the final session, on the afternoon of June 10, will be made a conclave of bankers, industrial men and representatives of Western chambers of commerce. At this time the electrical industry will present its side of the broad question of the economic upbuilding of the West. An extensive survey of Western industry has been made, and the results and conclusions arrived at will be given. At the banquet in the evening addresses on this subject will be made by various men prominent in finance, commerce and industry.

Fourteen papers and committee reports from the various sub-committees of the Commercial Section and of the Technical Section have been prepared for presentation. In addition to the program of the technical section given on page 278 of the Jan. 29 issue of the ELECTRICAL WORLD, there will be the following papers: "Evaporation from Reservoirs," "Industrial Electrical Heating," "Long-Range Weather Forecasting," "Operation for Maximum Output and Operating Record," and "The How and Why of Better Industrial and Commercial Lighting."

Reports, Papers and Entertainment Program of Canadian Convention

QUEBEC CITY will be the meeting place of the Canadian Electrical Association on June 15, 16 and 17, when the association will hold its thirty-first annual convention at the Chateau Frontenac. The following program of reports and papers will be carried out:

WEDNESDAY, JUNE 15

Morning.—Report of secretary-treasurer; report of Technical Section, R. J. Beaumont, Shawinigan Water & Power Company, chairman; report of meter committee, E. Holder, Shawinigan Water & Power Company, chairman; "Electrical Standards and Their Application to Trade and Commerce," by O. Higman, director Electrical Standards Laboratory, Ottawa; report of electrical apparatus committee, W. J. S. Wurtele, Southern Canada Power Company, chairman.

Afternoon.—Report of overhead systems committee, O. V. Anderson, Toronto Power Company, chairman; report of Commercial Section, M. C. Gilman, Montreal Light, Heat & Power Consolidated, chairman; "The Consulting Engineer and the Power Company," by J. M. Robertson, Montreal.

THURSDAY, JUNE 16

Morning.—"Modern Street Lighting," by A. B. Cooper, Canadian General Electric Company, Toronto; "Electrons," by W. B. Cartmel, Northern Electric Company; "Switching Equipment," by L. B. Chubbuck, Canadian Westinghouse Company, Hamilton; "The Manufacture and Testing of High-Tension Porcelain Insulators," by A. D. Allen, Hamilton, Ont.

Afternoon.—Report of Accounting Section, D. R. Street, Ottawa Electric Company, chairman; report of Public Relations Section, D. H. McDougall, Toronto Power Company, chairman; report of accident prevention committee, Wills Maclachlan, Toronto, chairman; report of membership committee, M. K. Pike, Northern Electric Company, chairman; report from representatives on Canadian Engineering Standards Association: "Pole Specifications" by O. V. Anderson, "Electrical Appliances and Supplies" by E. C. McGovern, "Transformers" by A. A. Dion; report on activities of Toronto Section and St. Maurice Valley Section.

On Friday morning classes A and D will meet in executive session. Entertainment features of the gathering will include an excursion to Ste. Anne de Beaupré and Montmorency Falls on Wednesday afternoon and sight-seeing and boat trips on the following day. The annual dinner, to be held at the Kent House on Wednesday evening, will be addressed by the president of the National Electric Light Association and William L. Goodwin of the Society for Electrical Development.

More Hydro-Electric Projects Licensed

FIVE licenses and seven preliminary permits were authorized by the Federal Power Commission on May 20. The licenses are to cover the following applications (the numeral is the serial number of the application): 82—Alabama Power Company; 104—The Home Colony Association; 126—John R. Love and G. A. Vonbrecht; 192—C. B. Johnson; 203—Thomas P. Mitchell.

Preliminary permits were authorized as follows: 113—Great Basin Power Company; 81—Granite Falls Manufacturing Company; 48—State of Illinois; 7—Roanoke River Development Company; 121—James B. Girand; 88—Merced Irrigation District; 20—Utah Power & Light Company.

The Alabama Power Company project covers a power development in the Coosa River at Duncan's Riffle, Ala., below the present plant at Lock 12. A concrete dam 335 ft. in height at its crest will be built. The power house will be an integral part of the dam, having provision for an ultimate installation of five units. The initial installation will be two units of 24,000 hp. each. A 110,000-volt line will be built to the company's existing plant at Lock 12. The license will provide that work must be started on or before Sept. 1 and the initial installation be completed before Sept. 1, 1924.

The Home Colony Associations' project is for only 10 hp. to supply summer homes on Kitty Creek, Wyo.

The Love-Vonbrecht project covers existing works on the Salmon River in the vicinity of Custer, Idaho.

The Johnson project is for 7,927 ft. of transmission line to be erected in Inyo County, Cal., and to connect with a 33,000-volt line of the city of Los Angeles.

The Mitchell project covers 2 miles of single-circuit 10,000-hp. line in Ouray County, Col., to be connected with the Western Colorado Power system.

The preliminary permit which is to be granted to the Great Basin Power Company covers a 3,950-hp. development on the West and North Forks of the Duchesne River in Utah. Four transmission lines of a total length of 245 miles are proposed. The applicant estimates that the cost of the project will be $1,000,000. The permit is to be limited to two years.

The preliminary permit to be granted the Granite Falls Manufacturing Company at Hickory, N. C., covers

a power project on Wilson Creek in Caldwell County to develop 8,000 hp. The power is to be used for public utility purposes. Application for license must be filed before Oct. 1.

The preliminary permit asked for the State of Illinois covers power development at four sites on the Illinois waterway which is being constructed by the State. The power sites are at Brandon Road below Joliet on the Desplaines River at Dresden Island in the Illinois River at Marseilles and at Starved Rock on the Illinois River. Locks will be located at the power sites. It is the intention to utilize the excess flow above the needs of navigation for the generation of electric power. The permit will specify that it is not to be construed as an authorization for the diversion of water from Lake Michigan.

A preliminary permit to be issued to the Roanoke River Development Company of Richmond, Va., covers a project of 10,000 primary horsepower contemplated at Buggs Island in the Roanoke River near Clarksville, Va. It is expected that 50,000 secondary horsepower will be available. The permit will be limited to two years.

The preliminary permit which is to be issued to James B. Girand of Phoenix, Ariz., covers a power project in the canyon of the Colorado River just above the mouth of Diamond Creek, in Mohave County, Ariz., for various mining and irrigation uses.

The preliminary permit to be issued to the Merced Irrigation District, Merced, Cal., covers a project on the Merced River near Exchequer, Mariposa County, Cal., in which power will be subservient to the irrigation demands. During three months of the winter no power will be developed. The power developed will probably be fed into the San Joaquin Light & Power System.

The preliminary permit asked by the Utah Power & Light Company of Salt Lake City covers a power development in Bear River, in southeastern Idaho. A total development of 21,500 hp. is contemplated at four points, as follows: Soda Point, 6,000 hp.; Lava, 6,000 hp.; Narrows, 4,000 hp.; Mink Creek, 5,500 hp. The permit will be for a period of thirty-three months.

California Electrical Men Continue Co-operative Endeavor

THREE hundred and fifty men of the electrical industry, principally from the San Francisco Bay district, met at the annual meeting and "get-together" dinner of the California Electrical Co-operative Campaign in San Francisco on May 18. L. H. Newbert, chairman of the advisory committee, in addressing the meeting pointed out that the outstanding evidence of the success of the California movement was that it has been adopted in several other sections of the country.

H. F. Jackson, general manager of the Great Western Power Company, said that the test of the full power of the co-operative movement would come in the next year or two, when the supply of electrical energy and utilization devices would exceed the normal demand in California. W. E. Creed, president of the Pacific Gas & Electric Company, pointed out that the public service corporations lay at the foundations of modern existence and that a clearer conception of this fact must be brought home to every one in industry and agriculture. He stated that the success of the financing of power development in the West depended upon informing the people of the relation of industrial growth to electrical power supply.

Calvert Townley Suggests New Method of Stimulating World Trade

SPEAKING at a banquet held at Rochester, N. Y., recently by the local section of the American Institute of Electrical Engineers and six other technical societies, Calvert Townley, past-president of the A. I. E. E. and assistant to the president of the Westinghouse Electric & Manufacturing Company, ascribed the present stagnation of industry and commerce to the breaking down of export trade and suggested as a remedy the buying up of the most promising European industries by American capital and their operation under American management, providing work at good wages for European labor, so as to create general prosperity on the other side of the water and thus restore normal purchasing power. In the meantime, he pointed out, the securities of the industries taken over could be converted through the banks into American securities.

Semi-Centennial of the British Institution of Electrical Engineers

FIFTY years ago, on May 18, 1871, the Society of Telegraph Engineers was founded in London by a small body of military officers, scientists and electricians. This body has expanded into the Institution of Electrical Engineers, which has today nearly ten thousand members. Appropriate celebration of the society's "jubilee" is made in the columns of the London *Electrician* of May 13. Only two of the original sixty-six members are still living—Col. E. D. Malcolm and Sir Herbert Jekyll. Each of these pioneers contributes a few reminiscences of the early days, and the development of the society is discussed by President L. B. Atkinson and J. E. Kingsbury.

The broadening interests of the early society are sufficiently indicated in its changes of name. In December, 1880, the title was amended by the addition of the words "and of Electricians." In 1889 the present title was adopted. It was early recognized that the society had been founded to promote electrical science in all its branches. Later it developed from a body with a purely scientific objective into what, as expressed by the *Electrician*, it now is—"the representative body of a great industry anxious to put forward its opinions on and be consulted about everything which affects electrical interests."

Amendments to Water-Power Regulations Not Acted On

THE proposed amendments to the administrative regulations promulgated in connection with the water-power act were not considered at the meeting of the Federal Power Commission held May 20. Secretary Fall could not be present at that meeting, and it is desired to have all of the members of the commission present when these amendments are discussed. Beginning with June, the commission will meet regularly on the first and third Mondays of each month.

With the idea of conserving the time of the three secretaries it has been decided that in the future hearings will be held in the first instance by the executive secretary, who will render a preliminary decision. Appeal may be taken to the commission; otherwise the preliminary decision will be presented to the commission for approval.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Railway Electrification in Germany.—A European correspondent of the ELECTRICAL WORLD writes that the Ministry of Communications has just made the first appropriation of 40,000,000 marks for the electrification of the railway line from Munich to Regensburg, one of the principal lines in Bavaria.

Growth of Utilities Mutual Insurance Company.—The seventh annual report of the Utilities Mutual Insurance Company shows a growth in earned premiums for 1920 over 1919 of $211,700, the total amount for 1920 being $704,700. Since the organization of the company the earned premiums have amounted to $2,190,200 and the dividends paid to $485,000. Assets as of Dec. 31, 1920, are placed at $1,047,400, against liabilities of $632,800.

Hydro-Electric City in Ontario Gets Clear of Debt to Commission.—Guelph, a place of 15,000 population, is the first of the twelve cities which originally went into the Hydro-Electric Power Commission enterprise of Ontario to get clear of debt to the commission, and it is now turning its attention to the improvement of the city lighting system. The total cost of the plant in Guelph was $269,533, while the total surplus and depreciation reserve amounts to $210,945, and the sinking fund and debentures paid to $62,610.

Taxing Electric Lighting.—According to our Japanese contemporary *Denki-notomo*, a search for new sources of revenue has led the local government of Tokushima Province to seek to impose a tax on electric lighting graded according to the candlepower of the lamps in use. The permission of the central government is, however, necessary before such a tax can be enforced, and the electrical industrial societies of Japan have protested vigorously and hope to prevail on the central government to withhold consent to the plan.

Prone Pressure Saves Another Life.—Irving Staples, a foreman employed by the Central Maine Power Company, a short time ago, while "shooting trouble" on the company's high-tension system and attempting to use a portable telephone set, short-circuited the line and fell back with jaws set and blackened face, apparently dead. Linemen Butler and Linnell thought he was, but nevertheless started in with the prone-pressure treatment and after twenty minutes' work were rewarded by noticing a faint trace of breathing. When a physician arrived Staples was sitting up not greatly the worse for his narrow escape, which would have been impossible save for the company's instruction of its employees in life-saving methods.

Voluntary Rate Reduction in Missouri.—The Caruthersville & Kennett Electric Light & Power Company bears the distinction of being the first to ask the Missouri Public Service Commission to reduce its charges, the receivers of the company, J. S. Wahl and W. R. Shelton, Jr., having asked for a reduction of 5 per cent in present lighting rates. The company voluntarily went into the hands of receivers last October, not being able to pay interest on its bonds. In December, 1920, the commission increased the rates of the company 25 per cent, and the receivers now ask that this rate be reduced for the six months beginning June 1.

Industrial Teachers' Scholarships in New York.—The University of the State of New York is offering twenty-five scholarships to qualified industrially and technically trained persons who desire to prepare themselves for teaching. Persons selected to hold these scholarships who satisfactorily complete the prescribed one-year resident training course are licensed for life to teach their specific occupations in the vocational schools of the state. The salaries paid vocational teachers now range from $1,800 to $3,500 per annum. Detailed information can be had from the director of vocational and extension education, State Department of Education, Albany, N. Y.

California Railroad Commission Seeks Information on Price of Crude Oil.—Press reports of a reduction in the price of crude oil, in contradiction to the expressed opinion of a Standard Oil representative testifying recently before the California Railroad Commission, have led the body named to address to the Standard Oil Company and three other large oil companies of the state a request for prompt information on present and possible future reductions in the price of the product in question. This information, the commission says, is of special importance in view of the fact that there are pending before it a number of rate proceedings affecting electric and gas utilities in which the price of oil has a material bearing.

Coast Guard Cutters to Have Electric Drive.—The first of four electrically propelled cutters that are being built for the United States Coast Guard Service was launched a few weeks ago at Oakland, Cal. It measures 240 ft. in length by 39 ft. in width and 25½ ft. in depth and has a displacement of 1,600 tons. The boat has been named the Tampa after the Coast Guard cutter that was taken from the Florida station in the war to convoy American transports and was sunk in Bristol Channel in September, 1918, presumably by an enemy submarine, every man on board being lost. One of the advantages of the new drive is that the cutters so equipped will be much easier to control and can be reversed in much quicker time than the old type.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Association of Municipal Electrical Utilities of Ontario.—The semi-annual convention of this association will be held at the Clifton House, Niagara Falls, Ontario, assembling on Thursday, June 23.

Outing of Philadelphia Section, A. I. and S. E. E.—Next Saturday, June 4, the Philadelphia Section of the Association of Iron and Steel Electrical Engineers will hold its annual outing at Valley Forge, Pa.

British Electrical Engineers to Have New President.—The council of the Institution of Electrical Engineers has selected John Somerville Highfeld, a consulting engineer of London, for the presidency of that body, which becomes vacant on Sept. 30, in succession to Llewellyn B. Atkinson.

Japanese Society Elections.—Japan has an Institute of Electrical Engineers and also a Society of Illuminating Engineers among her engineering associations. Of the former Dr. Ho Ito, professor of electrical engineering in the Imperial University of Tokyo, has recently been elected president, while Dr. E. Aoyagi, professor of electrical engineering at the Kyoto Imperial University, has been elected as head of the illuminating engineers.

Coming Meetings of Electrical and Other Technical Societies

N. E. L. A. Annual Convention—Chicago, May 31-June 3. (For program see issue of May 7, page 1065.)

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

Northwest Electric Light and Power Association—Portland, Ore., June 15-18. (For program see issue of May 21, page 1180.)

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17.

American Society for Testing Materials—Asbury Park, N. J., June 15-18.

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

City May Sue for Benefit of Its Inhabitants.—In City of Saginaw vs. Consumers' Power Company the Supreme Court of Michigan affirmed the right of a city, as representative of its inhabitants, to sue an electric utility to compel specific performance of its contract, in order that a multiplicity of suits may be avoided. 182 N. W. 146.)*

Rights of Courts and Commission in Michigan.—The Public Utilities Commission law of Michigan did not, the Supreme Court of that state has held, in City of Saginaw vs. Consumers' Power Company, deprive the courts of the jurisdiction of a controversy presented by bill by a city in behalf of itself and its inhabitants to enforce specifically a contract of a utility to furnish electricity at certain rates, there being no question of adequate service involved and no previous acquisition by the commission of jurisdiction over the matter. • (182 N. W. 146.)

Service Charge Permitted for Gas but Denied for Electricity.—In passing upon a motion for an injunction sought by the Meridian (Miss.) Light & Railway Company against the city of Meridian to prevent the enforcement of domestic rates fixed by the city, the United States District Court sustained the company in regard to a service charge of 75 cents a month for gas which it desired to collect but refused to permit a service charge for electric lighting. The court, however, decided against the city in the matter of rates for electric power, holding that the city was without legislative authority to prescribe a tariff of rates for motor service.

Contributory Negligence for Court When Facts Are Undisputed.—Ordinarily the question of contributory negligence is one to be submitted to the jury under appropriate instructions, but where the facts are uncontroverted and there is no room for reasonable difference of opinion the court is under duty to determine the question as a matter of law and instruct accordingly. So declaring, the Court of Appeals of Kentucky reversed a verdict for the plaintiff in Winfrey vs. City of Owensboro and Owensboro City Railway Company and ordered new trials. This was a peculiar accident case in which wind had blown down electric transmission wires across the road. Passing drivers shoveled dirt over the wires and attempted to cross, the wagon wheels sank through to the wires, the horses were shocked, and in attempting to unharness them the plaintiff's husband was killed. The contributory negligence of the victim, a man fully aware of the danger from escaping electricity, was held by the superior court to be manifest. (221 S. W. 135.)

Company Not Liable for Death of Boy Who Climbed Tower and Grasped Wire.—Damages were awarded by a jury in a circuit court to the father of a boy killed by electric shock and burns received when he climbed a tower to a height of 35 ft. and grasped a wire passing within 12 in. or 15 in. of this tower (Bonniwell vs. Milwaukee Light, Heat & Traction Company). The Supreme Court of Wisconsin has reversed the verdict, disregarding the alleged grounds of negligence on the part of the company based on the statement that although it had allowed boys to play around and climb upon the base of the tower it had not so installed and protected its lines as to make it impossible for a venturesome boy to meet injury from its high-tension wires. The boy, the Supreme Court held, was a trespasser when he climbed the tower whether or not he was a licensee while playing at its foot, and the company, which had placed conspicuous signs of warning on its towers, had not failed in precautionary measures. (182 N. W. 468.)

Validity of Franchise Contracts.—The following statement of fundamental principles underlying franchise contracts was laid down by the United States District Court for the Western Division of Pennsylvania in American Prake Shoe & Foundry Company vs. Pittsburgh Railways Company, a suit involving franchises granted to the railway company by the city of McKeesport: "The public has an interest in every contract entered into by a public service corporation, whether it be a contract by writing and signed by both parties thereto or a contract arising by reason of the passing of a municipal ordinance and its acceptance by the public service corporation intended to be affected thereby. Such contracts, because of the interest of the public therein, are not to be classed with those personal and private contracts the impairment of which is forbidden by constitutional provisions. The public service corporation cannot charge undue and excessive rates, for such conduct would be oppressive to the public. On the other hand, the public cannot continue to use the instrumentalities of the private corporation without permitting to the owners thereof a fair return upon a fair value of such property (not dividends upon inflated capital or interest upon excessive bonded indebtedness), for such refusal would amount to confiscation. To avoid oppression on the one hand and confiscation on the other should be the mutual desire of the parties interested in such franchise contracts." (270 Fed. 812.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Rural Rates in Illinois.—The Illinois Public Utilities Commission has denied an application from the Spring Valley Utilities Company to place in effect revised regulations governing its rural electric service. Although admitting that the proposed charges appear just and reasonable, the commission was obliged to reject them because they did not conform to its uniform schedule of rural rates, to which, it holds, close adherence must be imposed.

Line Extensions in New York.—In ordering the People's Gas & Electric Company of Oswego to extend its lines a distance of about one mile to serve outlying customers provided that a certain number of signed applications for service from such connections are filed the New York Public Service Commission for the Second District said, alluding to principles established by the United States Supreme Court: "This company is in a prosperous condition, and there is no claim that suffering a small loss on the proposed extension would render its business as a whole unprofitable. While this company holds its franchise it is fair to presume no other company could procure one to operate in this territory. The applicants can get no electricity unless they are supplied by this company. It is the duty of the company to supply their needs, if practicable. The cost of the extension is not the only matter for consideration."

"Going-Concern Value."—In passing on an application for an increase in natural-gas rates, the Montana Public Service Commission took occasion to reiterate its previously stated view of "going-concern value" as follows: "There can be no question of our duty to make an allowance for 'going-concern value' in a rate case involving an established utility, and here we must be careful to determine what going concern value is: 'The value which inheres in a plant where its business is established, as distinguished from one which has yet to establish its business.' The test is whether the bare bones are assembled in place, connected to function, and under human management, in motion rendering service to a dependent clientele. Neither the absence of good will nor of remunerative returns necessarily disparages the reality of 'going-concern value.' Consumers may be positively hostile to the plant, which may just be able to meet operating expenses, and yet the plant possesses 'going concern value' because its business is established."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Samuel Insull, president of the Commonwealth Edison Company and chairman of the board of directors of the People's Gas Light & Coke Company, was born in London, England, on Nov. 11, 1859. He was educated in private schools at London, Reading and Oxford, England, and came to America in 1881. Mr. Insull began his business career as private secretary to Col. George E. Gouraud in London from January, 1879, to February, 1881. Colonel Gouraud was Thomas A. Edison's representative in London in connection with telephone and other matters. During the time of Mr. Insull's connection with Colonel Gouraud the Edison Telephone Company of London was organized. In March, 1881, Mr. Insull came to the United States to act as private secretary to Mr. Edison, the arrangements under which he obtained this connection having been made through Edward H. Johnson, whose acquaintance he had made in London. Mr. Edison and the Edison Electric Light Company established headquarters at 65 Fifth Avenue, New York, and started the commercial development of the Edison central-station light and power system in February, 1881. Mr. Insull's first duties as Mr. Edison's private secretary were to assist him in the establishment of the various manufacturing concerns which were founded in connection with the commercial development of the electric lighting system. These establishments were the Electric Tube Company, the Edison Lamp Company and the Edison Machine Works. Mr. Insull's duty, besides having general charge of Mr. Edison's other business affairs, was to take care of the financing of the three establishments in question and to advise and assist in the financing of Bergmann & Company, in which Mr. Edison had also acquired an interest. In 1887 the Edison Machine Works, which had been established on the East Side of New York in 1881 and which had ultimately absorbed the Electric Tube Company—established in 1881 at 65 Washington Street and later on having a shop in Brooklyn—were moved to Schenectady, N. Y. At this time Charles Batchelor was general manager of the Edison Machine Works, Mr. Insull was secretary and treasurer and John Kruesi was assistant general manager.

Mr. Insull took up his residence in Schenectady in 1887 and assumed, at Mr. Edison's request, the general management of the Schenectady works with Mr. Kruesi as his assistant, Mr. Batchelor confining himself mainly to work at Orange, N. J., in Mr. Edison's laboratory. The development and management of the Schenectady works were under Mr. Insull's charge from their establishment at Schenectady in 1887 until 1892. He continued as general manager until 1889, when with the Edison Light Company the various Edison manufacturing concerns were consolidated into the Edison General Electric Company, of which he was second vice-president in charge of the manufacturing and selling departments until 1892. At that time another consolidation, with the Thomson-Houston Company, resulted in the organization of the General Electric Company. Mr. Insull continued as second vice-president of this new company until June, 1892, when he resigned.

Mr. Insull then became president of the Chicago Edison Company and of the Commonwealth Electric Company, 1892-1907, and later of the Commonwealth Edison Company, after the consolidation in 1907. He is in addition chairman and president of the People's Gas Light & Coke Company of Chicago, president Public Service Company of Northern Illinois, president Middle West Utilities Company, chairman executive committee Chicago Elevated Railways, chairman board of directors Chicago, North Shore & Milwaukee Railroad and Chicago & Interurban Traction Company, member of committee Chicago and City Connecting Railways Collateral Trust, and chairman board of directors Northwestern Elevated Railroad Company, South Side Elevated Railroad and Metropolitan Elevated Railroad Company of Chicago. These various companies have a gross business of more than $100,000,000 per annum and have securities outstanding of about $470,000,000.

Union College of Schenectady, N. Y., on June 13, 1917, conferred upon Mr. Insull the degree of doctor of science in recognition of his achievements as an organizer and administrator.

During the war Mr. Insull, as chairman of the Illinois State Council of Defense, devoted his entire time to the war work carried on in the state as the active head of the body named.

He is a member of the American Institute of Electrical Engineers, of the Institution of Electrical Engineers (British) and of numerous other technical bodies.

William T. MacPherson has been appointed chairman of the central committee on co-operation maintained by the Public Service Company of Northern Illinois to govern relations between company and employees. Mr. MacPherson, who takes the place of J. L. Hecht, recently elected assistant to vice-president, will be in the general office of the company at Chicago. He began his employment with the Northwestern Gas Light & Coke Company in 1911, going into the organization of the Public Service company when it took over the properties of the former corporation. On being mustered out of army service in 1918 he was made superintendent of District O and held that position until recently.

Owen D. Young, vice-president of the General Electric Company, was elected a director of the Merchants' Association of New York City at its annual meeting, May 17.

Obituary

Col. Charles M. Jarvis, for many years one of the outstanding figures in the steel-structure production industry, died May 21. He was well known in the electrical field, particularly in the nineties, when as president and chief engineer of the Berlin Iron Bridge Company he designed and built numerous steel structures for electrical generating and manufacturing plants. Later he organized the American Bridge Company as a subsidiary of the United States Steel Corporation. This organization also does extensive work in the electrical field in building construction and transmission-line tower fabrication.

Col. J. F. Strickland, a well-known pioneer in the development of electric light, power and railway service in Texas, died in Dallas on May 21. Mr. Strickland was born near Gadsden, Ala., Dec. 9, 1860. He moved to Texas in 1878 and had been closely associated with public utilities since 1897. At that time he was engaged to manage an electric light business at Waxahachie, Tex., and to operate a mule-drawn street-car line. In 1906 he organized the Texas Traction Company, which built an interurban line between Dallas and Dennison. In 1912 he organized the Southern Traction Company, which built lines between Dallas and Waco and between Dallas and Corsicana. These two companies were merged in 1917 under the name of the Texas Electric Railway, whose lines totaled 215 miles in length. In 1912 Colonel Strickland was the head of a syndicate which controlled the electric light properties in Waco. Cleburne, Hillsboro, Waxahachie, Sherman and Bonham. These properties he sold to a new company, known as the Texas Power & Light Company, which now serves ninety-four communities. At the time of his death Colonel Strickland was president of the Texas Power & Light Company, Dallas Power & Light Company, Dallas Railway Company, Texas Electric Railway and also Dallas Securities and Union Trust companies. He was one of the organizers of the Southwestern Electrical & Gas Association and had been prominent in all electrical affairs of the Southwest, including the Jovian Order, with which he was early identified.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Returning Market in Air-Circuit-Breaker Field

ALTHOUGH the market for air-break circuit breakers can be characterized as only fair, nevertheless reports from manufacturers indicate a real upward trend in business. In general March has been better than February and April better than March, while May has started out at a still better rate than April. Much of this business, however, has resulted from intensive sales efforts and has not come by any waiting policy. The market presents a spotty tone at times rather than an even flow of business. But the total adds up fairly well, and it is felt that by the late summer or fall this business will have picked up considerably.

A feature of the ordering is the quick shipments that are so often required. Apparently customers have waited till the last moment to order, and generally they have been accommodated. Shipments from factory stock are commonly made, and up to two weeks is about as long as is necessary to fill a bill. Whole panels using air-break equipment seldom take more than three weeks now. Much of this air-break equipment can be stocked and most manufacturers are working toward this end.

Industrial plant buying is very quiet. Utilities are providing considerable activity, and the same can be said for hotels, apartment houses, etc., for use on either street service or isolated plant lines. For the large station boards there is little market at present. Electric railway buying, both for station and for substation boards, is reported extremely dull.

Factory operation is well below capacity, probably 50 per cent, and overhead and labor charges are still heavy under these conditions. Raw-material prices are down considerably, it is true, but with labor entering into the breaker cost so materially certain producers have made no change in prices. On the other hand, there have this year been recessions from the peak of from 10 per cent to 25 per cent by certain manufacturers.

Noticeable Pick-up in House Meter Business

CONSIDERABLE activity is reported in sales of integrating watt-hour meters for residential use. For the time being industrial concerns are making few extensions and sales of power meters are very quiet. One of the more active sources is shown to be among summer-resort customers because central stations have made it a practice in several communities to remove meters from summer places after these have been closed for the winter and use them in needed locations on their lines. These meters have filled a temporary demand and new ones are now being bought to supply the summer demand again. Suburban wiring of old houses also is enlarging the meter demand.

Central-station companies in general througout the country are buying only as needed, but several of the larger ones have begun to look forward a bit and have placed orders which will form the basis of a fair stock. This is rather more noticeable in the eastern and central belts of the country, where the demand is such as to provide a really fair meter business.

Meter manufacturers are not working to their full capacity but are operating sufficiently to supply present demand and at the same time lay aside stocks in large enough quantity to enable them to fill orders from stock and still not have these stocks topheavy. The gradual working up to this condition and the holding of a constant level is the manufacturers' aim. Factory stocks now are not such in every case that they would be able to satisfy a real summer demand and a buying spurt, it is felt, would work stocks down to a low level.

According to the permits for buildings filed during the month of April the increase in building activity should be pronounced in the months to come. Compared with the permits filed for the first three months of this year, April stands out well. It will probably be midsummer before these permits come through to the electric wiring stage, but the meter outlook is already better than it was a month ago and it is believed will become still better as the year advances.

Similarity of Forms and Colors for Jobbers' Consideration

TWO of the subjects submitted for discussion at the meetings of the Electrical Supply Jobbers' Association, which came to a close at Hot Springs, Va., on May 27, were the standardization of methods and forms within the jobbing house and the standardization of paper color for discount sheets.

The committee on methods and forms, F. E. Stow chairman, in its report submitted recommendations on the general methods to be followed and forms to be used in the purchasing, receiving, shipping and charging departments in electrical supply jobbing houses. A standard purchase form shown carried only two requests—that the order number be placed on invoices and packages and that the bill of lading be inclosed with the invoice. The size of sheet, 8½ in. x 11 in., and the arrangement of printing were definitely recommended.

For the receiving clerk a bound book containing receiving forms printed in accordance with the sample presented was recommended by the committee. For shipping and charging departments it was recommended that every jobber establish and maintain a stock record system, suggestions for which were presented.

To eliminate the confusion frequently experienced with the varieties of colors used for discount sheets covering the different classes of the trade samples of two weights of paper in four colors were prepared for presentation at the convention. The scheme would allot russet brown paper for distributers' lists, goldenrod for jobbers' prices, blue for contractor-dealers' prices and pink for consumers.

Lower Prices Quoted on Brass Rods, Sheets and Tubes

REDUCTIONS in brass prices of the order of 1 cent per pound were announced last week in manufacturing circles. Makers of schedule material expressed to the ELECTRICAL WORLD their satisfaction in this reduction upon receipt of the new price lists. At present business in the brass field as related to electrical production is much below normal, but a leading producer of socket-shell material said last week that the May business had been considerably better than that of April. The chief demand just now is for copper products. Competition for business is very acute. Reductions in wages and salaries of the order of 10 per cent have lately been made in the brass industries, and some

of the mills are running on half to two-thirds time. A 10,000-lb. order looks large today.

There has been no change in the price of copper products since April 18, according to a representative manufacturing establishment. The new base prices for brass in quantity lots as issued by a leading house are as follows: Sheet metal, high brass, 16¼ cents per pound; low brass, 17¾ cents. Wire, high brass, 17¼ cents; low brass, 18¾ cents. Rods, high brass, 14¼ cents; low brass, 18¾ cents. Brazed tubes, brass 27½ cents. Seamless tubes, high brass, 20 cents; low brass, 21½ cents; copper, 22 cents; copper sheets, 20.50 to 20.75 cents; copper bottoms, 28 to 28.25 cents; copper rods, round, 19.25 cents.

Swiss Electrical Manufacturers' High Production Costs

THE Swiss electrical industry, which has always been dependent upon exportation, is finding itself in a very critical position, according to the ELECTRICAL WORLD'S correspondent in Switzerland. This statement applies especially to the large plants turning out all kinds of electric machinery. In order to be able to compete with foreign manufacturers it will be necessary to reduce the cost of production as well as the wages of the workmen. As to the latter a comparison was recently published by the Association of Swiss Machinery Manufacturers showing the average wages per hour of adult workmen in the machinery and metal industries at the end of 1920 as follows:

	Home Currency	Swiss Currency
Germany	6.00 to 6.50 marks	59-63 centimes
Austria	35.00 crowns	61 centimes
Italy	2.40 lire	58 centimes
France	2.15 to 2.80 francs	88–115 centimes
Belgium	2.30 francs	99 centimes
Switzerland	1.76 francs	176 centimes

From these figures it will be seen that wages in Switzerland are considerably higher than in any of the competing countries. Furthermore, Switzerland has to import most of the raw material used in her electrical industries, and only a reduction in the cost of production as well as a reduction in wages will enable the Swiss plants to compete successfully in foreign markets.

Schedule Material Makers More Than Holding Their Own

MANUFACTURERS of schedule material, while operating considerably below their plant capacity and on shortened weekly time, spoke, when visited by a representative of the ELECTRICAL WORLD last week, of a real improvement in business conditions. There is a feeling abroad in the trade that the low point of the depression is now well astern. In one representative establishment, for example, actual orders received during the first fifteen days of May correspond to an index number of 100. The corresponding orders for the first half of April on this scale were 68, for March 90, for February 93, and for January 68. This included both domestic and foreign business booked during the first fifteen days of the above months and indicates a real improvement in trade. Another good-sized concern asserted that while the plant is running four days a week just now an expected slump in orders during May did not materialize. The originating business does not appear to be confined to one section of the country but is well spread around, and in one case at least foreign orders are as high as 40 per cent of normal. In the face of the present exchange situation this is considered a remarkably good showing.

During the expansion period many manufacturers by vigorous efforts accumulated heavy stocks of raw material purchased at high prices. A large amount of this material is still on hand to be worked up. This runs into big figures and in one case easily approaches half a million dollars. It has not yet been possible for such manufacturers to take active advantage of the recessions in the prices of copper, brass and other commodities entering into their own output. Undoubtedly as soon as existing raw material supplies in the factories run low enough purchases of the raw commodities at lowered rates will be made on a much larger scale. Just as manufacturers wish to liquidate these stocks before committing themselves to large purchases many jobbers desire to dispose of their supplies of sockets, switches, etc., before placing large orders with the factories.

The improvement in the building trade in some parts of the country where construction has been at a standstill for a considerable time is helping, even if moderately, to improve conditions in the production and sale of wiring devices. Some price adjustments have occurred and others are naturally to be expected from time to time, but it is pointed out that drastic cuts in one or two lines by concerns of small size and very limited facilities by no means prove that prices can be sharply cut in relation to the thousands of items which make up this great class of electrical material.

Labor conditions now are much better from the productive standpoint, although wages have not been reduced much as yet. Domestic-appliance fittings are moving reasonably well, and the outlook for the conservative manufacturer is believed to be very much better than it was even a few weeks ago.

The Metal Market Situation

FURTHER improvement is noted in the copper market and prices have again stiffened. The two factors responsible for this are the continued gain of the statistical position and strong export buying. Domestic consumers have been feeling out the market but they have not purchased to any great extent. Total sales of copper for export last week are estimated at about 24,000,000 lb., of which total Germany and France were large buyers. The export price at present is about 13.25 cents f.a.s. New York.

Producers have raised their prices to 13.37½ to 13.50 cents delivered for prompt, May and early June shipment, but late June is held at ¼ cent advance over that and July at 13.75 cents delivered. For the entire third quarter from 13.75 cents to 14 cents is asked, and there seems to be some speculative interest in August and September deliveries at those prices. As noted elsewhere this week new lists have been issued reducing brass and bronze products about 1 cent per pound.

Lead buying is very small as demand has fallen away to a large extent following the recent price increases. The domestic market for zinc is inactive, foreign buying is flat and prices are easy. Tin shows no evidence of resumption in demand either, and consumption in England is almost at a standstill by reason of adverse conditions such as the coal strike.

The scrap metal market displays little life. Buying of scrap copper, especially heavy metals, is the main feature and prices there are slightly firmer.

NEW YORK METAL MARKET PRICE

	May 17, 1921	May 24, 1921
Copper	£ s d	£ s d
London, standard spot	74 2 6	74 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13.00—13.25	13.25
Electrolytic	13.00	13.12½–13.50
Casting	12.25	12.62½
Wire base	14.50—15.00	14.75—15.00
Lead, trust price	5.00	5.00
Antimony	5.25	5.25
Nickel, Ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	10.00	10.00
Zinc, spot	5.35	5.25
Tin	33.00	32.25
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.25—10.62½	10.50—10.75
Brass, heavy	5.25— 5.50	5.25— 5.50
Brass, light	4.00— 4.12½	4.00— 4.25
Lead, heavy	4.25— 4.50	4.25— 4.40
Zinc, old scrap	2.50— 2.75	2.50— 2.75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

THE tone in the supply jobbing field is distinctly upward, coming from an increasing number of orders and inquiries that have turned to orders rather than from larger orders in themselves. New York, St. Louis, Atlanta and Boston territories show better return in this respect, the district outside of Chicago is active, while Chicago itself is quiet. The Northwest jobbers too are somewhat better off. The Intermountain section is quiet, and California, except in the south, is not very active. Building labor difficulties still affect business in and around San Francisco and in Chicago, but otherwise April activity showed a favorable increase over the first three months of the year.

Ability of manufacturers to make quick shipments on supplies permits jobbers to run close to the edge on their stocks, and they are reordering only to keep stocks in a sufficiently liquid condition to handle current trade. There has been a 25 per cent reduction in "Nail-it" knobs, and locally wire, flexible armored conductors, pipe and schedule material have shown softening tendencies.

NEW YORK

A general improvement to trade last week is indicated by reports received from jobbers, most of whom notice a slight but distinct increase in sales covering the whole electrical supply line. Orders were not larger in themselves but were received in greater number.

A 25 per cent price decrease on "Nail-it" knobs has been made. Prices on armored conductor are being cut materially, also on schedule material. Conduit and rubber-covered wire quotations are soft too. Some activity in fan buying is reported recently. Stocks in almost every line are good, while overstocks are reported on very few items, chiefly socket heating devices, some lines of schedule material and wire.

Buying is only for maintenance, and the trade seems satisfied that business depression will last until about September. There are hopeful signs in the building industry, however. The strike of 12,000 building trades workers in Westchester County has been settled with a cut in wages of $1 per day, and the tie-up of the local brick supply through the strikes of the brick handlers and of the barge captains now seems to be nearing an end. The value of building permits issued in New York City during April totaled about $30,000,000, compared with a total of $63,000,000 for the entire first quarter.

Outlet Boxes.—The supply is uniformly good, but demand is spotty. In lots of 100 the quoted discount on black boxes ranges from 45 to 50 per cent and on galvanized from 40 to 45 per cent.

Flexible Armored Conductor.—The average nominal market for No. 14, two-wire, double-strip, at present is about $55 to $57 in 1,000-ft. lots, but prices in this territory are being cut right and left. Quotations far below the above prices have been reported, but it is doubtful if they are legitimate offers. Demand is light and stocks are fair.

Lock-Nuts, Washers and Bushings.—Although cable connectors have dropped as reported last week, no price change has occurred on this material. Several jobbers are allowing 50 to 55 per cent discount in standard packages, but others give as high as 65 to 68 per cent off. Good supplies are held, but demand is light.

Rubber-Covered Wire.—The market is weak and stocks are still fairly large. From $6.75 to $7 per 1,000 ft. is quoted this week on 10,000 ft. of No. 14 single-braid.

Heaters.—Some few were sold early this month during the cold weather which prevailed, but the spring season has been a disappointment and supplies on hand now will have to be carried over. Stocks are spotty. All jobbers exercised great caution in buying, and as a result a goodly number are cleaned out, while on the other hand stocks up to 3,000 are reported.

Porcelain.—A decrease in the price of "Nail-it" knobs, effective May 20, has been announced. The cut, which is made by increasing the discount 8⅓ points, amounts to about 25 per cent. Tubes and cleats are not affected by the change.

Schedule Material.—Considerable price cutting is being done, but supplies are not moving. One jobber at least is overstocked on sockets, but in general it is only on a few special items that a surplus is carried because houses are merely replenishing stock and no more.

CHICAGO

Another quiet week has passed with the electrical industry apparently doing better than most other lines. The local employment situation is no better.

Outside of Chicago things are gradually improving, and it is only a matter of time till Chicago trade is favorably influenced thereby. In the electrical jobbing trade the statement is frequently made that while inquiries are no more numerous than during March and April more of them are being turned into orders than before. Business is notably better in schedule material and in inside wire, and many rewiring and alteration jobs are under way.

In certain places it is felt that the local construction labor trouble will be settled before June 1, and if that is true an immense volume of work will immediately proceed. In anticipation of such a conclusion to the negotiations now being carried out dealers are building up stocks of construction materials. Prices in general are a little lower, and it is felt that a gradual decline will be in evidence for some time.

Wire.—Copper wire, bare, has registered no change, 16½ cents per pound still ruling on lots of ordinary size. No. 14 rubber-covered, at $7 per 1,000 ft. in 10,000-ft. lots, is unchanged. On smaller quantities 25 cents more is asked. Weatherproof is easier, on a 15-cent base, the No. 6 triple-braid now being offered at 16½ cents per pound in quantities of 1,000 lb.

Flexible Armored Conductor.—No. 14, two-wire, double-strip, at $57.50 per 1,000 ft., represents a drop of about 5 per cent. Sales have been very slow but are better now. The local trade seems to expect lower prices in the near future, although some few contractors and dealers are now acquiring stock.

Black Conduit.—In spite of the fact that it was said the price of conduit had anticipated the April reduction in steel further price recessions have occurred. In 1,000-lb. lots ½-in. black conduit is now offered at $59 per 1,000 ft.; in 5,000-lb. lots it is $1 less. Price cuts have developed a fairly lively demand, particularly from the country districts.

Knobs, Tubes and Cleats.—Overstocks never having developed trade is good as demand is heavy on account of the large amount of alteration and rewiring work being done. Split knobs, without nails, No. 5½, are quoted at $17 per 1,000 in barrel lots, the "Nail-it" variety at $23. Tubes, ⅝-in. x 3-in., in similar quantity, are $8 per 1,000.

Lock-Nuts and Bushings.—In common with other wiring accessories these are in good demand, jobbers' price on lock-nuts being $1 per 100, and on bushings $1.85 per 100.

Fuses.—Owing to decreased industrial activity trade in fuses of large size is dull. Small sizes are in good demand. Non-renewable type, most in demand on country orders, are quoted at $13.40 per 100 on the 0-amp. to 30-amp. size and $20.10 per 100 on the 30-amp. to 60-amp. size, 250-volt rating.

BOSTON

A marked improvement was evident at the beginning of the week in the volume of orders handled by electrical jobbers and manufacturers in various lines. It is felt in many quarters that a distinct advance is being made toward better times. Collections are holding up reasonably well, and on the whole the tendency is toward improved conditions. Raw materials are plentiful and the prices of these have been pretty thoroughly liquidated, according to leading industrial executives. The gradual liquidation of labor continues, with decided improvement in individual efficiency. Jobbers' stocks are being replenished by moderate purchases. Deliveries are excellent, and prices, while firm in many lines, exhibit a downward tendency in wiring material of the heavier sort. Building and engineering contracts in New England for the week ended May 17 totaled $3,796,600, an excellent showing compared with most recent years. Full recovery of electrical contracting business is retarded by labor troubles. A little more expansive buying by central-station companies is reported. It has been announced that construction work on war vessels will occupy the Fore River shipyard to the extent of about $40,000,000 during the next two years.

Wire.—Sales of rubber-covered wire became active last week, one house disposing of about 600,000 ft. of No. 14. Stocks are good, and in lots of 5,000 ft. to 25,000 ft., $7 per 1,000 ft. is a going price. Above 25,000 ft. no fixed prices prevail, a typical figure being $6.75 per 1,000. Moderate sales of weatherproof are noted on a 16½-cent base, and bare copper wire is selling around a 15½-cent base. Some steam-railroad wire purchases featured the market.

"Nail-it" Knobs.—A leading house reduced prices Monday as follows: Less than unit quantity, $40 to $35 per 1,000; unit quantity, $32.75 to $25 per 1,000; standard package quantity (barrel lots), $27 to $21 per 1,000. This change is expected to stimulate sales perceptibly. Stocks are ample.

Flexible Armored Conductor.—This material is moving better than of late. Increased building construction is absorbing more and scattered orders of small-size help to swell the total. Deliveries are good, No. 14 double-strip selling at $65 per 1,000 ft. in coil to 1,000-ft. lots.

Fittings.—Prices are steady with fair sales only. All armored conductor fittings except couplings are selling at 25 per cent off double manufacturing list in less than standard-package lots, with 40 per cent off on 2,500 assorted. Connector prices range from $9 per 100 in less than standard packages to $6.50 per 100 in lots of 500 only.

Non-Metallic Flexible Conduit.—Some ⅞-in. conduit is moving, a representative price in 5,000-ft. lots being $21.

Dry Cells.—A pretty active demand is reported for automobile service. The No. 6 cell brings $37.35 per 100 in barrel lots, the ignition type moving at $38.35.

Rigid Conduit.—The market is rather dull on account of the slow revival of building operations. Some pipe is moving, however, in small orders. Black conduit in 2,500-lb. lots sells for $67.30 per 1,000 ft. in the ½-in. size and for $131.20 in the 1-in. diameter. Galvanized pipe in these sizes is quoted respectively at $72.40 and $141.40.

Appliances.—A few fans were sold Monday as a result of the sudden but short-lived spurt of hot weather. Reduced prices on flatirons, it is believed by leading distributers, will increase buying.

ATLANTA

While business for the month of May has not so far equaled in volume that of March, jobbers report an increasing display of interest on the part of dealers and contractors in the small towns and outlying districts. There is a marked increase in the number of inquiries being received, and while orders continue to be small in size the volume is slowly increasing. The organization of banking houses to assist in the export of Southern products and the establishment of local branches under the federal farm-loan bank act is serving to create a feeling of confidence in the agricultural sections, and this, of course, is reflected in a better outlook in the small communities. Inquiries from large industrial plants continue to be received, and quite a number of additions and improvements are being undertaken. Wage reductions in the building trades are stimulating the construction of small residences and commercial houses and also repairs.

A general improvement in operating conditions is expected to stimulate maintenance and new construction work on the part of small central-station companies and municipalities within the next sixty or ninety days in anticipation of fall requirements.

Fans.—The unseasonable weather has served to check the movement of both desk and ceiling fans, though this check is but temporary. Stocks are on hand in sufficient quantities to last until July 1, and jobbers anticipate a good season.

Heating Devices.—Despite a reduction of 10 per cent little or no volume to sales is noted. Flatirons continue to hold a fairly steady gait, but hollow ware might be said to be dead. Jobbers report heavy stocks in all lines.

Safety Switches.—The demand continues to increase slowly, the most popular sizes being the two-pole, 30-amp., and three-pole, 60-amp. and 100-amp. Although one manufacturer has announced a price reduction the other manufacturers state that no reductions are contemplated in their lines. Fair stocks are on hand with shipments good.

Tape.—A brisk movement has followed a price reduction of 15 per cent and stocks have become very spotty. One of the leading jobbers is having to bring in shipments by express to meet the demand. Black friction tape is quoted at 40 cents per pound and shipments average two to three weeks.

Call and Signal Systems.—In spite of the large number of inquiries and quotations that are outstanding this line continues dull, buyers apparently holding off on account of prices. Jobbers report ability to get shipments very promptly.

Distribution Transformers.—A steady though not large sale of transformers, particularly in sizes up to 5 kw., is reported with occasional large sizes in demand. This will increase slightly as the damage from lightning during the summer season begins to be felt. Stocks are in excellent shape and shipments satisfactory.

Lightning Arresters.—A fair volume of sales is reported, but it is not up to expectations or to that of former seasons. The compression type is selling comparatively well. Stocks have been allowed to run rather low in certain types, but shipments are satisfactory. A price reduction of 10 per cent was announced recently.

Single-Phase Motors.—Supply has caught up with demand in this line and the movement is rather sluggish.

ST. LOUIS

There was but one occurrence of note of an industrial nature during the past week—the reopening of the largest automobile assembly plant here on a 20 per cent production basis. This gives employment to a good many men, and the result is a feeling on the part of the general public of increased stability in business. Electrical jobbers report a marked increase for the week in sales of general supplies. The demand for electrical materials entering into construction enterprises is still quite slack. There is an underlying feeling that the costs of building materials are higher locally than should be the case, and investigations are being conducted by the state. Because of the slow reductions in materials and labor there is a tendency to postpone construction work still further.

Stocks in the hands of the electrical jobbers are considered to be kept on a low basis. This can readily be done, for the manufacturers in general are maintaining ample stocks to meet all immediate requirements. Some are increasing their stocks of copper wire because of the extremely favorable prices now prevailing.

Only a small amount of new power business is reported by the utilities because of the lack of industrial activity. A number of large inquiries are on hand, however, and betterment is expected this fall.

Fuses.—An increase of fourteen points in the discount on renewable fuses is reported by a large jobber this week. On this basis, 30-amp. renewables in standard packages are selling at 29 cents each, net. Non-renewable, N.E.C., 30-amp. fuses in standard packages sell at 9 cents to 10 cents each. A continued steady demand is experienced in all kinds and sizes.

Lamp Cord.—Stocks of lamp cord may be a trifle too heavy, and the demand is quite low. Prices remain firm, No. 18 twisted cotton pair being quoted at $16 per 1,000 ft. in 5,000-ft. lengths.

Wire.—Some improvement in the demand for all kinds is reported, probably due to the extremely low prices prevailing. No. 14, rubber-covered, is quoted from $6.50 to $7.00 per 1,000 ft. in 5,000-ft. lots, the general quotation being $6.75. Special brands of wire are selling in large lots as low as $6.35. The St. Louis base on bare copper wire is about 15½ cents, and that for weatherproof from 15 cents to 16 cents.

Flexible Armored Conductor.—Very little demand was experienced last week. The price remains at $60 per 1,000 ft. in 5,000-ft. lots and is firmly maintained, though stocks are somewhat heavy.

Conduit.—A steady but low call for conduit is found, the demand being principally for minor changes in industrial plants. The ½-in. black is selling from $61 to $70 per 1,000 ft. The tendency is to keep stocks at a minimum in the expectancy of lower prices.

Knobs and Tubes.—Prices are being firmly maintained. "Nail-it" knobs are quoted from $24 to $28 per 1,000 and 2½-in. tubes at about $8.50 per 1,000. The demand is low and consists of small replenishments of contractors' stocks.

SAN FRANCISCO

There is a large amount of building in southern California, but it has fallen off to a mere trickle in the San Francisco Bay district because of the building strike. Appliance business has been mending steadily during the present month, although the volume is still far short of last season.

The labor situation in San Francisco is particularly critical. Building operations are virtually at a standstill and a bitter fight to a finish is expected. It is probable this fight will be extended to neighboring counties and that building operations there will soon be similarly affected. Disappointing news comes from Washington in the refusal of the Senate to sanction an expenditure ultimately amounting to $20,000,000 on a naval base for which a site had been selected in Alameda, opposite San Francisco. It is confidently felt, however, that the base is not finally lost.

Household Material.—Appliance dealers report better selling conditions during May with a trend toward normal. Although schedule material and wiring staples have dropped household appliances have changed very little in their retail prices since last fall. The standard washing machines still average $160 or $170 and the standard vacuum cleaners about $60 f.o.b. Pacific Coast. Some dealers assert that even price reductions will not stimulate the buying public, who seem to be withholding their purchases as much for doubt of events in the immediate future as for lower prices in definite articles. Sewing machines are receiving special attention, a number of demonstrations of table-top machines being reported as well as an increase in sales on the portable types, all makes seeming to participate in the sales increase. Dishwashers are especially active, nearly every dealer and department store displaying or demonstrating a sample.

Schedule Material.—The building strike has caused an almost complete cessation of jobbers' orders from the districts affected. Not only have the stock orders dwindled, but even the small pick-ups of semi-special articles have dropped off, and this is a valuable gage of existing business. Local manufacturers' stocks are very good and jobbers are depending upon them without purchasing unduly large quantities. Renewable fuses have decreased about 30 per cent in package-quantity prices. Stocks are very good, and the sales have dropped off and are principally for refills with spasmodic orders for the larger cases.

SALT LAKE CITY—DENVER

Business generally was sluggish during the past week. Jobbers are coming to the point of accepting the prevailing conditions for what they actually are and increasing their efforts accordingly to find an outlet for merchandise.

Few applications for building permits have been filed in the past week in the larger city centers. Construction of buildings involving big investments is scarcely known. Contractor-dealers, however, are finding relief in the small-home-building campaign that is now launched. That it will grow in volume as the season progresses is the belief. Complaint is heard on every hand that the high price of skilled labor is the biggest obstacle to general construction work. Indications point to the gradual, though slow, absorption of unemployed labor in agricultural and other industries.

Banks are not yet in a shape to relax their rigid stand in money matters, and loans are still next to impossible to obtain. This stringency is reflected particularly in collections, which show little improvement from week to week. June 6 to 11 has been designated jobbers' week in the Intermountain region. Dealers who can be induced to come to jobbing centers to make purchases will have their railroad fares rebated to them, provided that their purchases reach a scheduled amount.

Fans.—Fan business to date is disappointing. The weather continues cold and stormy and dealers show little interest in stocking. Jobbers are well prepared to meet demands in any quantities and look for a big movement with the advent of the first spell of hot weather.

Lamps.—Incandescent lamps are moving slowly as the active season tapers off. Dealers have had a good year and there is no complaint of excessive stocks.

Lamp Cord.—The growing use of lighting fixtures is making big inroads on the lamp-cord business. Supply on hand is ample for all needs.

Street-Lighting Installations.—Cities and larger towns are making inquiries into street-lighting possibilities. The general wave of civic improvement is given as the cause of the unusual interest. Several big contracts have recently been completed.

SEATTLE—PORTLAND

Manufacturers in this district report that there is a considerably stronger feeling of optimism abroad than there has been for some little time past. This, however, has not as yet expressed itself in increased volume of business. Collections remain slow, although they are no worse than they have been. Jobbers report a slight increase in business for the week, but this change is so little that it would not be worthy of note were it not that it is felt. While it is hoped it indicates the general trend there are many conditions which at the present act to offset this slight improvement. However, the general tone is more optimistic. Credits are very tight. Many smaller businesses are holding on by sufferance at the present time. The contracting business is decidedly spotty. Reports from Portland indicate that a large number of residences are being constructed. The electrical workers' strike, called in defiance of the general agreement, has been temporarily adjusted, but will probably become acute again on Sept. 1, at the expiration of the present agreement.

Dealers are finding business in general to be very slow. Apprehension is felt in some places as to what may be the development in the next few months. The maritime strike has tied up exports to a very considerable extent. Many boats are loaded and ready to leave Portland, Seattle and other Northwestern ports, but they cannot obtain crews.

Conduit.—At present there are no big orders; in fact, Seattle jobbers report sales 50 per cent under those of last year. This condition is attributed to light building of larger-sized structures, but here, where considerable construction of moment has started and a large amount is projected, the conduit situation is expected to improve materially at once. Stocks are in excellent shape and replacements easy to obtain.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Atlanta Jobber Continues After Fire Damage

The place of business of the Gilham-Schoen Electric Company, Atlanta, Ga., jobbers and Westinghouse distributers in that district, was badly damaged by fire in the early morning of May 16. Most of the damage was covered by insurance. Although experiencing considerable inconvenience, the company is continuing to carry on the business as usual.

"Ingeniería Internacional" Issues New Foreign Trade Bulletin

In its desire to work closely with the manufacturers of engineering and industrial equipment in this country in the building up of their trade with Latin America, *Ingeniería Internacional*, published by the McGraw-Hill Company, Inc., at Tenth Avenue and Thirty-sixth Street, New York, has issued Volume 1, Number 1, of "International Engineering," a foreign trade bulletin. Printed in English, its function and purpose are to show how American manufacturers may cement sound economic and commercial relations with the great potential market in the Spanish-reading countries and to explain and interpret the work of *Ingeniería Internacional* in forwarding these purposes."

High Average Sales in Apex Cleaner Contest

According to R. J. Strittmatter, sales manager of the Apex Electrical Distributing Company, Cleveland, there is no question as far as that company is concerned as to the value of prize contests as a stimulant to the salesman. The experience gained from the contest just closed merely serves as a repetition of the results of former contests. The sales contest was on "Apex" electric suction cleaners for wholesale selling organizations of the company's distributers and the retail salesmen of these distributers' dealers.

For the seven weeks' duration of this contest the winning salesman in the first class averaged better than 100 cleaners a week. He was located with the company's Utica (N. Y.) distributer, in a territory which previously had been characterized as very poor. In the retail division the winner was located in Cedar Rapids, Iowa, and he averaged twenty-one cleaners per week in this period.

Another contest is about to start for dealers in the smaller towns, and the company expects a real stimulant to its sales during the ordinarily slow months of June and July.

Penn Electrical Occupies New Quarters

The Penn Electrical Engineering Company, electrical supply jobber of Scranton, Pa., has acquired its own building at 517-521 Ash Street. In moving to these quarters the entire organization is brought together—offices, warehouse and repair shop—in the endeavor to provide the maximum of service.

Line Equipment Sales Agencies for Raymond Roth

Raymond Roth has located at 30 Church Street, New York City, where he has opened a district sales engineering office, covering the central Atlantic district, representing Schweitzer & Conrad on switching and protection equipment, the G. & W. Electric Specialty Company for distribution specialties, the Hopewell Insulation & Manufacturing Company, and the MacGillis & Gibbs Company on cedar posts, poles and ties.

New Jobber Incorporates in Syracuse

The Baldwin-Hall Company, Syracuse, N. Y., has been incorporated to do a wholesale business in electrical supplies and electrical machinery. Fred S. Baldwin is president and William H. Hall, Jr., is secretary and treasurer. The company has purchased the four-story building at 309 East Water Street, in a location well adapted to wholesale electrical business.

Jacobus Arresters to Be Sold by Multiple Electric Company

Following the introduction of the Jacobus vacuum lightning arresters on railroads in the United States, it has been decided to prosecute the sale of this apparatus most extensively throughout the United States and Canada. With this end in view E. Jacobus advises that the entire sale has been placed in the hands of the Multiple Electric Products Company, Inc., 450 Fourth Avenue, New York City, manufacturer of "Atlas" multiple fuses, through the offices and sales organization of which both this country and Canada will be covered.

"Creative Credit Management" Is New Slogan of Credit Men

Broad Financial Educational Program Among Contractors and Dealers, Based on Conception by Credit Managers of Their Opportunities, to Be Carried Out

"Creative credit management" is to be the new slogan of the electrical credit managers of the United States if the spirit and purpose of the twenty-second annual convention of the National Electrical Credit Association, held at Richmond, Va., May 19 and 20, hold firm throughout the coming association year. For too long a time electrical credit men have concentrated on problems of credit restrictions and difficulties of collections. This is the opinion of the association leaders, who are now making plans to carry out a broad financial educational program among electrical contractors and dealers and to bring credit managers to a larger conception of their opportunities to help build credits and increase sales.

This new spirit and these forward-looking plans were evidenced throughout the proceedings of the convention, the program of which was published in these columns on May 14. "Better Business Methods," a discussion and demonstration by J. A. Corcoran, General Electric Company, was one of the features of the convention, and the enthusiastic attention with which Mr. Corcoran was received and the discussion that followed indicated the purpose of the credit men present to acquaint themselves more thoroughly with successful merchandising methods.

Robert Edwards, Jr., of New York, was elected president of the association for the ensuing year; Clarence Kaeber, of Philadelphia, was elected vice-president, and Frederic P. Vose, Chicago, was re-elected secretary-treasurer.

Not the least interesting features of the convention were a tour of Washington and of Richmond and the battlefields surrounding the city and a golf tournament on the links of the Virginia Country Club.

The convention referred to the board of managers a number of important questions for action, including the question as to whether the territory west of the Connecticut River in the State of Connecticut, now a part of the New York Electrical Credit Association territory, should be ceded to the Electrical Credit Association, New England Division; the place for the 1922 convention; the establishment of a policy with reference to cash discounts, and the appointment of a committee on publicity and the working out of a definite program for that committee during the forthcoming year.

The Monitor Controller Company, Baltimore, has established a Cleveland office at 420 Permanent Building, in charge of Robert Notvest.

The Kentucky Electric Lamp Company, Owensboro, Ky., has filed notice of increase in capital stock from $100,000 to $200,000.

The Cook Electric Company, Newark, N. J., has filed plans for the erection of a one-story plant, 40 ft. x 75 ft., at 360-64 Jeliff Avenue, to cost about $20,000.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, in order to co-operate more closely with its jobbers in the Middle West, has established a branch office at 1711 Grand Avenue, Kansas City, in charge of J. N. LaBelle, formerly assistant manager of the Chicago branch. The Kansas City branch includes Kansas, Nebraska, Oklahoma, Texas, Arkansas, western Louisiana and western Missouri. Mr. LaBelle will be assisted by Emery Harris, who will make his headquarters at Omaha, Neb., and R. Brice Shipley, who will travel in Oklahoma, Texas, Arkansas, western Louisiana.

The Display Stage Lighting Company, 314 West Forty-fourth Street, New York City, has filed notice of an increase in capital stock from $50,000 to $100,000.

The Reliance Electric & Engineering Company, Cleveland, has removed its Chicago office to Room 2013 Fisher Building. Edward F. J. Lindberg is district manager.

The M. J. Dougherty Company, Twenty-fifth Street and Washington Avenue, Philadelphia, announces a change of address of its Atlanta representative to Candler Annex. This office is in charge of Messrs. McKee and Wright, whose territory takes in the States of Florida, Georgia, Alabama, Tennessee, North Carolina and South Carolina.

The Fidelity Electric Company, Lancaster, Pa., has made arrangements with A. Edgar Goetz, 55 Barclay Street, New York City, to carry a stock of its motors, particularly in fractional sizes.

Foreign Trade Notes

PROPOSED WATER-POWER DEVELOPMENT IN JAPAN.—According to J. K. Steele, an official of the Oriental Steamship Company, Japan, is considering a water-power development that may involve the purchase of machinery and equipment in this country involving an expenditure of about $50,000,000.

WORLD FAIR FOR JAPAN IN 1922.—Announcement is made in a recent issue of the *World Salesman* of a fair to be held in Tokyo in March, 1922, which will be the largest of its kind ever held in Japan. The exhibition will consist of two blocks, connected by cable cars, which will comprise halls for educational, agricultural, electric, industrial and other exhibits; also halls for foreign products.

THE RECORD ENGINEERING COMPANY, LTD., Tutbury, Burton on Trent, England, manufacturer of internal-combustion engines, high-speed steam engines and steam traps, announces that because of the increase of its new business it has gone into voluntary liquidation with a view to reconstructing a much larger company to enable its demand to be met. Virtually the whole of the additional share capital is taken up by the present holders and their associates.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

ELECTRIC GENERATOR FOR FIJI ISLANDS.—The municipality of Suva, Fiji Islands, according to the *Electrical Industries*, will receive tenders until June 30 for a 200-kw., 480/520-volt, three-wire direct-current generator, directly connected to a 300-hp. vertical Diesel oil engine, together with accessories for generator and panel.

IMPROVEMENTS TO TELEPHONE SYSTEM OF MARANHAO, BRAZIL.—The Companhia Telephonica do Maranhao, according to reports from Consul Pickerell, has decided to remodel its plant completely and will require some 600 new instruments and other apparatus. The name and address of the director of the company may be obtained by referring to file No. 27,352.

ELECTRICALLY OPERATED PUMPS FOR MELBOURNE, AUSTRALIA. — The Board of Works, Melbourne, Australia, according to *Electrical Industries*, will receive tenders until Aug. 30 for four electrically operated centrifugal pumps, each having a daily capacity of 12,000,000 gal.

BIDS FOR THE ELECTRIFICATION OF THE SANTIAGO-VALPARAISO RAILWAY.—Bids will be received by the Railway Council until June 30, 1921, for the electrification of the first zone of the railway running from Santiago to Valparaiso. The cost, including electric locomotives, is estimated at 40,000,000 pesos.

CITIES OF PUERTO PLATA AND SANTIAGO TO PURCHASE LOCAL ELECTRIC PLANTS.—W. A. Bickers, council at Puerto, Plata, Santo Domingo, reports that negotiations have been nearly completed whereby the cities of Puerto Plata and Santiago will purchase their local electric plants. The price will be $400,000 in bonds, of which Puerto Plata will contribute $100,000 and Santiago $300,000. The most urgent improvement needed at present is the substitution of incandescent lamps for the arc lamps now in use for street lighting, and also many new iron poles as well as other materials for improving the transmission line to Santiago. Literature on electrical supplies and equipment may be addressed to the Honorable Ayuntamiento at Santiago and Puerto Plata.

CONCESSION FOR ELECTRIC TRANSMISSION LINE IN CHILE.—The Compañia General de Electricidad Industrial, a Chilean firm, according to a decree published in the Diario Oficial, has been authorized to erect a transmission line for the distribution of electricity between Rancagua and Paine, a distance of about 25 miles.

L. G. HAWKINS of L. G. Hawkins & Company, London, who represent the European interests of Landers, Frary & Clark and Edward Miller & Company, was due to arrive in the States on May 24. Manufacturers desiring to communicate with him should write in care of Landers, Frary & Clark, New Britain Conn.

EXTENSION OF DATE FOR OPENING TENDERS FOR ELECTRIFICATION OF RAILWAYS IN SOUTH AFRICA. — The date for receiving bids for equipment in connection with the electrification of the Cape Town-Simonstown and the Durban-Pietermaritzburg railway lines in South Africa has been extended from June 22 to July 5. Tenders should be addressed to High Commissioner for the Union of South Africa, Trafalgar Square, London, England.

New Apparatus and Publications

COMPENSATOR. — The Industrial Controller Company, Milwaukee, has recently placed on the market its new type "C" alternating-current compensator.

OIL CIRCUIT BREAKER.—Type F-10 oil circuit breaker, with an interrupting capacity of 10,000 amp. per phase at 15,000 volts, has been put on the market by the Condit Electrical Manufacturing Company, South Boston 27, Mass.

SWITCH BOX.—The Multiple Electric Products Company, 450 Fourth Avenue, New York City, has developed a switch box for lighting circuits where exposed molding or conduit wiring is employed.

INCLOSED SWITCHES. — The Wadsworth Electric Manufacturing Company, Covington, Ky., is distributing catalog No. 3, covering its "Compro" inclosed and externally operated switches.

WIRING DEVICES.—The Fernando C. Mesa Company, Irvington, N. J., is distributing bulletin No. 2 covering its electrical wiring devices.

PIPE STILLS. — The Power Specialty Company, 111 Broadway, New York City, is distributing bulletin 202, covering its pipe stills for oil refining.

AMPERE-HOUR METER.—The Sangamo Electric Company, Springfield, Ill., has issued bulletin No. 56, superseding bulletin No. 38, describing the Sangamo ampere-hour meter for controlling electroplating operations.

BATTERY-CHARGING BOARDS.—Bulletin L-1210, distributed by the Allen-Bradley Company, Milwaukee, describes its type L-1210 unit-panel battery-charging boards for electric vehicles and trucks.

AUTOMATIC COUNTERS. — The Root Company, Bristol, Conn., has issued catalog No. 31, covering the different types of "Root" automatic counters.

ELECTRIC HOISTS.—The Allis-Chalmers Manufacturing Company, Milwaukee, has issued bulletin No. 1819, covering its electric hoists.

OIL ENGINES.—The Anderson Foundry & Machine Company, Anderson, Ind., is distributing a folder describing its type "K" Anderson oil engines.

MAGNETIC PULLEYS. — The Dings Magnetic Separator Company, Milwaukee, is distributing a leaflet describing its magnetic pulley-type separator.

CONTROL APPARATUS — "Safest in the World" is the title of a sixteen-page book recently published by the Cutler-Hammer Company, Milwaukee, describing the new line of control apparatus recently developed for use with high-speed newspaper presses.

New Incorporations

THE MILLVALE (PA.) LIGHT COMPANY has been incorporated with a nominal capital of $5,000 to operate a local light and power system. C. J. Braun, Jr., 435 Sixth Street, Pittsburgh, is treasurer.

THE J. COMER JONES POWER & PUMP COMPANY, Boston, Mass., has been incorporated with a capital stock of $20,000 to manufacture electrical pumping machinery, etc. William E. Fennell is president and J. Comer Jones, 21 Winchester Street, Brookline, is treasurer.

CHARLES TISCH, INC., Brooklyn, N. Y., has been incorporated by J. J. Ryan, M. and Charles Tisch, 31 Irvington Place. The company is capitalized at $300,000 and proposes to manufacture electrical appliances and equipment.

THE RADIUM LIGHT O' DAY COMPANY, Newark, N. J., has been incorporated with a capital stock of $300,000 to manufacture electric lighting equipment. The incorporators are Ralph W. Dempwolf and Charles O. Johnston, 142 Market Street, Newark, and John S. Townsend, Haddonfield.

THE MODERN ELECTRICAL SUPPLY COMPANY, Newark, N. J., has been incorporated by A. and Max Schechter and William Lacks, 260 Springfield Avenue, Newark. The company is capitalized at $50,000 and proposes to manufacture electrical equipment.

THE SUPERIOR INCANDESCENT LAMP COMPANY, 593 Ogden Street, Newark, N. J., has been organized to manufacture electric lamps. Philip H. Harrison, 57 Babcock Place, West Orange, N. J., is interested in the company.

THE MacLAREN ELECTRIC APPLIANCE CORPORATION has been incorporated under the laws of Delaware with a capital of $2,500,000 to manufacture electrical appliances and similar equipment. C. M. Hicks, 291 Broadway, New York City, is representative. The company will operate in New York.

THE DAVENPORT (IA.) ELECTRICAL CONTRACT COMPANY has been incorporated with a capital stock of $20,000 and proposes to manufacture electrical goods and conduct an electrical contracting business. The incorporators are H. M. Heysinger, president; Richard Copley, vice-president, and George Hahn, secretary.

Record of Electrical Patents

Notes on United States Patents

(Issued April 26, 1921)

1,376,307. INSULATOR; Frank M. Amos, Wheeling, W. Va. App. filed April 9, 1920. Split knob insulator cannot come apart.

1,376,365. PROCESS OF PREPARING STENCIL PLATES, DIE PLATES AND THE LIKE; Gotthold E. Wertheimer, New York, N. Y. App. filed Dec. 24, 1917. Eroding by electrolytic action.

1,376,366. SOLUTION OR BATH FOR USE IN ELECTRICALLY PREPARING STENCIL PLATES, DIE PLATES AND THE LIKE; Gotthold E. Wertheimer, New York, N. Y. App. filed Dec. 24, 1917. Applied to annealed or hardened metals.

1,376,367, 1,376,368 and 1,376,369. SOLUTION OR BATH FOR USE IN ELECTRICALLY PREPARING STENCIL PLATES, DIE PLATES AND THE LIKE; Gotthold E. Wertheimer, Astoria, N. Y. App. filed May 16, 1918. Applied to annealed or hardened metals.

1,376,371. AUTOMATIC TELEPHONE SYSTEM; George A. Yanochowski, Chicago, Ill. App. filed Oct. 2, 1916. Metallic line.

1,376,379. SILVERWARE CLEANING AND WASHING MACHINE; George H. North, Cranston, R. I. App. filed May 17, 1920.

(Issued May 3, 1921)

1,376,391. TELEPHONE TOLL CIRCUITS; Oscar M. Arnold and John F. Toomey, New York, N. Y. App. filed Feb. 24, 1919. Private-branch exchange.

1,376,393. REVERSING MECHANISM FOR CYLINDER WASHING MACHINES; Fritz Balzer, Chicago, Ill. App. filed June 8, 1916.

1,376,396. RAIL BOND; John R. Brown, Mansfield, Ohio. App. filed Nov. 9, 1918.

1,376,399. ELECTRICAL MEASURING INSTRUMENT; Lewis W. Chubb, Pittsburgh, Pa. App. filed July 3, 1916. To measure root-mean-square of voltage.

1,376,400. MEANS FOR ELIMINATING DISTORTED HARMONICS FROM ALTERNATING-CURRENT GENERATORS; Lewis W. Chubb, Edgewood Park, Pa. App. filed Feb. 13, 1917.

1,376,401. CONNECTOR; Edward M. Claytor, Wilkinsburg, Pa. App. filed July 28, 1917. For testing purposes.

1,376,408. TROLLEY WHEEL; William B. Cullen, Westfield, Mass. App. filed July 21, 1919. Improved bearing surface.

1,376,415. ELECTRIC RANGE HEATING ELEMENT; Frank F. Forshee, Flint, Mich. App. filed May 15, 1919. Quickly connected.

1,376,417. BALANCING MEANS FOR POLYPHASE SYSTEMS; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 4, 1916. Machine used as shunt-phase balancer.

1,376,418. RELAY SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Sept. 9, 1916. For protecting parallel-connected feeder circuits.

1,376,419. POLYPHASE DISTRIBUTING SYSTEM; Charles L. G. Fortescue, Pittsburgh, Pa. App. filed Sept. 30, 1916. Phase-balancing means.

1,376,420. PHASE BALANCER; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 7, 1916. For maintaining symmetrical condition.

1,376,421. SINGLE-PHASE MOTOR; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Dec. 24, 1918. Commutator type.

1,376,422. POLYPHASE DISTRIBUTING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 18, 1916. For maintaining symmetrical conditions.

1,376,423. PHASE DISTRIBUTING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 18, 1916. For maintaining symmetrical polyphase conditions.

1,376,424. REGULATING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 7, 1916. To compensate for line losses.

1,376,425. MEANS FOR ELIMINATING HARMONICS IN POLYPHASE ALTERNATORS; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Jan. 29, 1917. For preventing flow of harmonic current.

1,376,426. MOTOR-CONTROL SYSTEM; Adolph A. Gazda, Wilkinsburg, Pa. App. filed Sept. 30, 1916. For printing presses and similar machines.

1,376,428. SELF-COMPONDING PHASE CONVERTER; Rudolf E. Hellmund, Swissvale, Pa. App. filed July 11, 1916. Component voltages automatically regulated.

1,376,429. PHASE-CONVERTER EXCITING SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1916. Component voltages automatically regulated.

1,376,430. METHOD OF AND APPARATUS FOR EXCITING PHASE CONVERTERS; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1916. Component voltages automatically regulated.

1,376,431. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed March 8, 1917. Accelerating and regenerative operation.

1,376,432. SYSTEM OF CONTROL FOR INDUCTION MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1917. Operated in cascade, with predetermined load distribution.

1,376,433. WINDING FOR DYNAMO-ELECTRIC MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 10, 1918. Alternating-current motors of closed-slot type.

1,376,434. METHOD OF AND APPARATUS FOR OPERATING INDUCTION MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Oct. 24, 1916. Starting and regulating induction machines.

1,376,452. CONTROLLING AND REGULATING APPARATUS FOR DYNAMO-ELECTRIC MACHINES; Friedrich W. Meyer, Milwaukee, Wis. App. filed Dec. 8, 1917. Use of direct-current motors, etc., on alternating current.

1,376,453. CONTROLLING AND REGULATING APPARATUS FOR ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES; Friedrich W. Meyer, Milwaukee, Wis. App. filed Jan. 21, 1918. Sensitive and stable regulation.

1,376,455. SYSTEM OF PRESSURE REGULATION; Edward T. Moore, Syracuse, N. Y. App. filed April 22, 1915. Employed in connection with pulpwood grinders.

1,376,470. LIQUID RHEOSTAT; Joseph Slepian, Wilkinsburg, Pa. App. filed April 18, 1919. To prevent corrosion of electrodes by sea water, etc.

1,376,471. APPARATUS FOR THE PRODUCTION OF A CHLORINE SOLUTION; Maurice G. Slocum, St. Joseph, Mo. App. filed Nov. 29, 1919. For strengthening solution of sodium chloride.

1,376,485. ELECTRIC HEATER; Edmond Verstraete, Belleville, N. J. App. filed Oct. 30, 1919. For ranges, etc.

1,376,486. ELECTRICAL INSULATOR; Kalman von Kando, Vado Ligure, Italy. App. filed Dec. 9, 1914. Trolley support.

1,376,495. ELECTROLYTIC CELL; John M. Williams, Guthrie, Okla. App. filed Sept. 5, 1916. For electrolyzing common salt.

1,376,501. COMBINED RIVET HEATER AND RIVETER; Alfred L. Atherton, Pittsburgh, Pa. App. filed Sept. 11, 1920. Heated by passage of current.

1,376,509. STEAM GENERATOR AND SUPERHEATER; Andrew J. Borst, Jr., Buffalo, N. Y. App. filed April 4, 1917. Electric current as heating medium.

1,376,512. ATTACHMENT FOR SMOOTHING IRONS; Ronald E. Campbell, Columbia, S. C. App. filed March 25, 1920. To convert sadiron into electric iron.

1,376,513. SAFETY ATTACHMENT FOR ELECTRIC IRONS; Ronald E. Campbell, Columbia, S. C. App. filed Sept. 8, 1920. Connection broken when handle is released.

1,376,563. PROCESS FOR THE PREPARATION OF PURE ALKALINE ALUMINATES; Paul Miguet, St. Julien-Montricher, France. App. filed Nov. 3, 1919. Free from acid oxides.

1,376,566. STORAGE BATTERY; John H. Murphy, New York, N. Y. App. filed May 12, 1920. Central lead grid serving as a brace against which outer layers of corrugated and perforated lead plates are placed.

1,376,581. PROCESS AND APPARATUS FOR THE PRODUCTION OF LEAD OXIDE; Harry S. Reed and Henry L. Publow, East Lansing, Mich. App. filed Sept. 17, 1920. From basic carbonates.

1,376,592. VARIOMETER; John S. E. Townsend, Oxford, England. App. filed April 10, 1918. Two ranges of inductance.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LINCOLN, ME.—The Bangor Railway & Electric Company has acquired the property of the Lincoln Light & Power Company. Extensive improvements are contemplated.

TOWNSHEND, VT.—The Public Service Commission has granted permission to the Townshend Electric Company, recently organized with a capital of $10,000, to supply electricity in Townshend. The company plans to erect a transmission line from Townshend to Newfane, where it will secure energy from the system of the Twin State Gas & Electric Company.

GREAT BARRINGTON, MASS. — The South Berkshire Power & Electric Company has acquired the Rockdale Mills and adjoining property at Rockland, to be used for extensions to the company's electrical system.

BRIDGEPORT, CONN.—The Crane Company, Chicago, Ill., is contemplating extensions and improvements to the power house at its local plant on South Avenue to cost, including equipment, about $125,000.

LYME, CONN. — The Lyme Electric Power Company has closed a contract with the Lyme lighting committee to supply electricity in Lyme. The line will extend from the lower Lieutenant River Bridge northward, a distance of 7 miles. Negotiations are under way, it is reported, to continue the line to Pleasant Valley.

TORRINGTON, CONN.—Steps have been taken by the Business Men's Association to secure an ornamental lighting system in the business district of the city.

Middle Atlantic States

ALBANY, N. Y. — The installation of electrically operated equipment at the city filtration plant is under consideration. The cost has been estimated at about $60,000.

BUFFALO, N. Y.—The City Council is considering the installation of a new lighting system on Genesee Street from Jefferson to Bailey Avenue.

CAPE VINCENT, N. Y.—The E. W. Coon Company contemplates rebuilding its cold-storage plant, recently destroyed by fire, causing a loss of about $400,000. Electric equipment, mechanical apparatus and refrigerating machinery will be required.

KENMORE, N. Y.—The installation of a new lighting system in the business district of Kenmore is under consideration by the village authorities.

LONG ISLAND CITY, L. I., N. Y.—The Quadri Color Company, 310 East Twenty-third Street, New York, contemplates the erection of a two-story plant, 104 ft. x 283 ft., at South Jane and Sunswick Streets and Van Alst Avenue, Long Island City, to cost about $400,000 with machinery. Motors and other electrical equipment, transmission and mechanical apparatus will be required. Hans A. Obst is president. E. G. Perrot, Woolworth Building, New York, is architect.

NIAGARA FALLS, N. Y.—The Milling & Lighting Company has applied to the Public Service Commission for permission to erect a new transmission line from its power plant to Nicholville.

NIAGARA FALLS, N. Y. — Arrangements have been made by the Niagara Falls Power Company to issue $6,000,000 in bonds, part of the proceeds to be used for the erection of its new hydro-electric plant. It is proposed to increase the output of the plant from 486,000 hp. to 673,500 hp. Foundation work for the new station is under way.

DOVER, N. J.—Arrangements are being made by the New Jersey Power & Light Company to extend the street-lighting system at Mount Arlington Borough to Jefferson Township, in the Lake Hopatcong section.

EAST ORANGE, N. J.—Negotiations are under way between the City Council and the Public Service Electric Company for the installation of an underground conduit system on Main Street in connection with the widening of the thoroughfares.

MADISON, N. J.—The Council has authorized an investigation for ascertaining the present condition of the municipal electric power plant and estimated cost of proposed improvements.

NEWARK, N. J.—The City Commission is considering the erection of a new municipal market building, 150 ft. x 604 ft., in the vicinity of Mulberry Street. The plans provide for the installation of a power plant, complete electrical equipment and electric signal system. Frank Grad, 245 Springfield Avenue, is architect.

ALLENTOWN, PA.—The City Council is considering extending the floodlight system on Hamilton Street to the Lehigh River Bridge.

ALTOONA, PA.—Bids will be received by the board of directors of the School District of Altoona until June 6 for building a central heating and power plant. Wood, Hulse, Yates & Company, 233 Broadway, New York City, are engineers.

WILKES-BARRE, PA.—The Lehigh & Wilkes-Barre Coal Company, 16 South River Street, is considering enlarging its steam power plant at Green Mountain colliery and installing additional equipment.

ANNAPOLIS, MD.—The Harper's Ferry Electric Light & Power Company has applied to the Public Service Commission for permission to extend its lines.

BALTIMORE, MD.—Arrangements have been made by the Board of Education for an appropriation of $250,000 for the installation of new heating and ventilating systems, with electrically operated equipment, in seventeen public school buildings. New power houses will also be erected, with equipment in fireproof partitions.

CUMBERLAND, MD.—An ordinance has been passed by the City Council requiring the installation of underground conduit lines on Mechanic Street by the Edison Electric Illuminating Company, Pennsylvania Railroad Company, Postal Telegraph Company, Western Union Telegraph Company and the Chesapeake & Potomac Telephone Company. An ornamental lighting system will also be installed.

THURMONT, MD.—Plans have been approved by the Council for the erection of a substation to be used as an auxiliary to the electric lighting plant.

AMHERST, VA.—The Amherst Electric & Power Company is considering the installation of a lighting system. W. A. Baldock is proprietor.

LYNCHBURG, VA. — A movement has been started by the City Council for the installation of a municipal electric light plant.

MONTVALE, VA. — H. M. Stephens & Son are considering the erection of a three-phase electric transmission line from Bedford to Montvale. Bids are being asked, it is understood, for copper wire, transformers, meters, electric fixtures, etc.

WASHINGTON, D. C.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until June 14 for furnishing flashlights and batteries for various Eastern and Western yards. Schedule 8056.

North Central States

BATTLE CREEK, MICH. — Plans are under consideration for remodeling the ornamental lighting system in the business district. It is proposed to replace the five-lamp cluster with single lamps.

DETROIT, MICH.—The Board of Directors of the Harper Hospital Association, it is reported, will take bids at once for a two-story addition, 88 ft. x 105 ft., to the power house to cost about $85,000. Albert Kahn, 1000 Marquette Building, is architect. Dr. Stewart Hamilton is superintendent.

CHILLICOTHE, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 6 for the installation complete of an electric dumbwaiter in the United States Post Office at Chillicothe, Ohio. James A. Wetmore is acting supervising architect.

NEWCASTLE, IND.—Bids will be received by the city clerk until June 6 for materials and equipment for a street-lighting system to cost about $11,500.

CHICAGO, ILL.—The Waterway Paper Company, Kedzie Avenue and Thirty-second Street, is having plans prepared for the erection of a new one-story factory 80 ft. x 180 ft., and power plant, to cost, including machinery, about $175,000. Frank D. Chase, Inc., 645 North Michigan Avenue, is architect and engineer.

FLORA, ILL.—Improvements to the municipal lighting system is under consideration.

GALESBURG, ILL. — Plans are being prepared by the city engineer for the installation of a fire-alarm system.

ROCKFORD, ILL.—The Rockford Electric Company contemplates an expenditure of $241,000 for improvements to its plant. The plans provide for building an outdoor switchboard, switch track and coal yard. Adam Gschwindt is general manager.

PRINCETON, WIS. — The Princeton Power & Light Company has increased its capital stock from $30,000 to $50,000, the proceeds to be used for the purchase of additional generating equipment.

TWO RIVERS, WIS.—Vaughn & Meyer, engineers, Security Building, Milwaukee, have prepared plans for improvements to the municipal electric plant, including remodeling switchboard and changing to the three-phase system, erecting steel poles and rebuilding electric distribution system. Joseph Doleysh is city clerk.

DARWIN, MINN.—The sum of $10,000, it is reported, has been raised to provide for electrical service in the village of Darwin.

COLUMBIA, MO.—The board of directors of the University of Missouri contemplates the construction of a steam-operated power house and heating plant at the institution. James P. Jamieson, Security Building, St. Louis, Mo., is architect.

SEDALIA, MO.—Plans for extensions to the ornamental street-lighting system have been approved by the Chamber of Commerce. The plans provide for 178 standards to cost about $37,500.

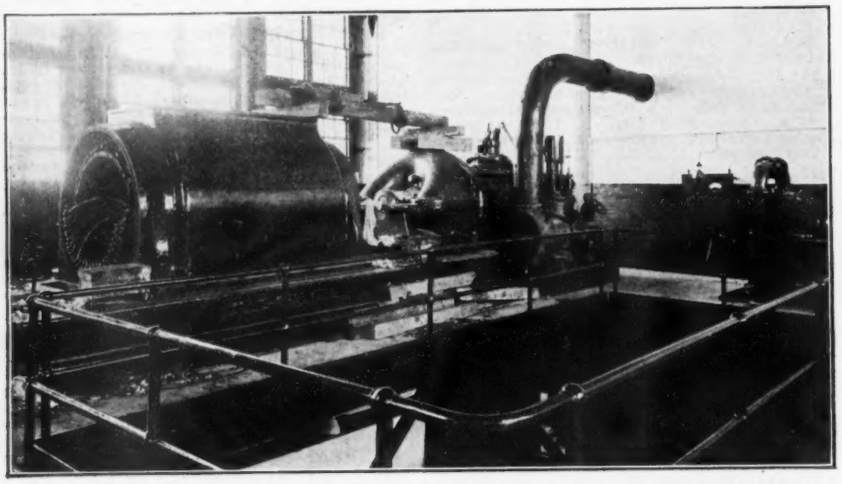
UNIONVILLE, MO. — Plans are being prepared for the construction of a municipal electric light and power plant to cost about $84,000. The Hennington Engineering Company, National Building, Omaha, Neb., is engineer.

DICKINSON, N. D.—The State Board of Administration contemplates the construction of a power plant to cost about $40,000 at the Dickinson Normal School. C. L. Pillsbury, Minneapolis, Minn., is engineer.

GRAND FORKS, N. D.—Additions to the power plant at the University of North Dakota to cost about $20,000 are contemplated by the State Board of Administration.

PAWNEE CITY, NEB.—Plans are being prepared for an addition to the municipal plant to cost about $85,000. E. T. Archer & Company, New England Building, Kansas City, Mo., are engineers.

HORTON, KAN.—Bids will be received by I. Griffith, city clerk, until May 31 for furnishing one Diesel engine and generator to be installed in the light and water plant.



THE 5,000-KVA. UNIT BEING ADDED TO THE EASTERN TEXAS ELECTRIC COMPANY'S PLANT AT PORT ARTHUR. THE ADDITION WAS BUILT BY STONE & WEBSTER

Southern States

CHESTERFIELD, S. C.—The plant of the Teal Light & Power Company, 7 miles from Chesterfield, was recently damaged by fire, causing a loss of about $12,000.

JACKSONVILLE, FLA. — Bonds to the amount of $1,000,000 have been voted for improvements to the municipal docks. Considerable electrical equipment will be required.

ORLANDO, FLA.—Investigations of the electric power plant are being made under direction of the Council with a view to installing new equipment or abandoning the station and erecting a new plant. Alvord & Burdick, 8 South Dearborn Street, Chicago, Ill., are engineers.

QUINCY, FLA.—Bonds to the amount of $175,000 have been voted for a municipal hydro-electric plant.

COOKEVILLE, TENN.—The erection of a dam at Burgess Falls is contemplated by the city officials. The project includes a 400-hp. hydro-electric plant. A. P. Barnes is Mayor.

MEMPHIS, TENN.—Extensions will be made to the river terminals at an estimated cost of $950,000. Considerable electrical equipment will be required. W. B. Fowler is city engineer.

BIRMINGHAM, ALA.—The Corona Coal Company contemplates the erection of a new electric power plant and coal washery at its Townley Mines. Electrically driven equipment will be installed.

DUNCAN, OKLA.—Bonds to the amount of $300,000 have been voted for the construction of a new 800-kw. municipal electric plant, distribution system and an ornamental lighting system. Benham & Mullergran, Firestone Building, Kansas City, Mo., are engineers.

EDINBURG, TEX.—At an election to be held May 31 a proposal to issue $30,000 in bonds for an electric light plant will be submitted to the voters.

Pacific and Mountain States

TACOMA, WASH. — The city has purchased a site at North Twenty-first and Adams Streets to be used as a site for a new transformer station for the municipal light department.

SAN FRANCISCO, CAL.—Application has been made to the Railroad Commission for permission to erect a transmission line from the Kerckhoff plant of the San Joaquin Light & Power Company to connect up with the system of the Pacific Gas & Electric Company.

DUCHESNE, UTAH. — The Great Basin Power Company, Salt Lake City, is having surveys made for the development of a 10,000-hp. hydro-electric plant, to include an earth dam 110 ft. high and an irrigation system to cover 25,000 acres. The cost is estimated at $1,500,000. H. A. Strauss, Walker Bank Building, Salt Lake City, is engineer.

Canada

KEMPTVILLE, ONT.—Preparations are being made for the erection of a transmission line by the Hydro-Electric Power Commission of Ontario from Merrickville to Kemptville.